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# 3D COLLABORATIVE VIRTUAL LEARNING ENVIRONMENTS: EDUCATIONAL GAME CREATION FOR TEACHING LATIN IN A FLIPPED CLASSROOM

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# Dedications

To my brave Mom for teaching me that the sky is not the limit.
There is a flag on the moon.

To my Grandma, my “mana mari”,
for being my umbrella when it’s raining.

To my Dad who Believed in me.
You are still here. You will always be.

To Jimmy for supporting me as a real father.
I am lucky to have you in my life.

And special dedications...
To Dimitris for Standing by me, by All means.
Stand by me. Life is better with you.

If you All hadn’t been there, I wouldn’t be here.

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Finally, I would also like to thank my fellow classmates for all the wonderful and unforgettable times we spent together.

# Abstract

The first aim of this thesis is to map the emerging research field of second language learning (SLL) in three dimension multi user virtual environments (3D MUVE's). The literature review is based on Webster and Watson methodology (2002). Positive findings identified in the 32 case studies examined, include evidence for improvement of the learning outcome and the communication skills and increase of the motivation. However, the current research is subject to significant limitations. The analysis draws attention to the need for creating multi user collaborative games and for considering the instructor's role. Further significant issues include the technical affordances of the environment.

The second aim is to develop and introduce an effective 3D educational game for learning Latin. The investigation of the literature review revealed that there are no games in a 3D MUVE, not only for learning Latin but also for learning other more popular languages. The game is built on the OpenSim platform and is designed based on the Ibrahim and Jaafar Educational Game Design Model (2009).The latter is enriched including important game principals in order to secure the entertaining character of the game and also, some pedagogical requirements in order to ensure that the game has an added educational value. The so called "Escape Domitian" game expects to motivate the students and give them an opportunity to use the language in a flipped classroom. The article concludes by identifying areas of potential interest in future research.

The contribution of this thesis to the research is a complete, systematic literature review missing from the field and an educational game based on pedagogical and technological requirements, missing from the field as well.



Keywords: 3DMUVE, SLL, CALL, virtual worlds, 3D game, collaborative, Latin, flipped learning

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# 1 .Introduction

## 1.1. Problem statement

Since the 1960s, computer technology has played an increasingly significant role in the learning and teaching of languages. (Atkins and Gaukrodger 2013). Advances in network technologies have resulted in constant changes in the Computer Assisted Language Learning (CALL) area that may improve the conditions in which language learning takes place. Among the emerging technologies that attract researchers' and educators' attention virtual worlds have a central role.

Virtual worlds are:

*''immersive, three-dimensional (3D), multimedia, multiperson simulation environments, where each participant adopts an alter ego and interacts with the world in real time. World activity persists even if a player is offline*.'' (Wagner 2009,p. 250)

It is remarkable that since 2009, the vice president of technology development for Linden Lab, Joe Miller, argued that language learning was the most common educational activity in Second Life (Lorenzo, Lezcano and Sánchez-Alonso 2013) which is the most popular virtual world platform as in 2013 it had more than one million users per month[1].

The 3D multi user virtual environments (3D MUVE) appear to hold great potential for second language learning and especially for applying principles of constructivism. Virtual worlds are considered to be suitable for constructing understanding through collaboration and interaction with other learners, objects and tools and for learning by doing. In addition,

since virtual worlds allow for rich social interactions and for problem solving multi-user

[1] https://www.lindenlab.com/releases/infographic-10-years-of-second-life

collaborative activities, which are necessary in a social constructivist-learning environment, they can foster language learning. (Wehner, Gump and Downey 2011) According to Pellas (2015) the potential benefits of the 3D multi user virtual environments in summary are:

- asynchronous or synchronous communication through a variety of tools such as (VoIP, IM or chat text for verbal or gestures for non-verbal)

- social interaction through synchronous real-time collaborative activities real time feedback from other peers or the instructor

- sense of simultaneous co-presence through avatars as students can study remotely in a common virtual place. The use of personal avatars not only provides a sense of embodiment, but also strengthens this feeling of presence

- sense of immersivity and engagement by implementing visually rich simulations

Another potential advantage of these environments is that they are considered to increase learners' motivation. Motivation has long been regarded as one of the most influential forces on a person's ability to learn, or not learn, a foreign language (Wehner, Gump and Downey 2011). In marked contrast to a lack of motivation in school learning, students are engaging in multi literacy activities outside of school spaces (Prensky, Engage me or enrage me: What today's learners demand 2005). Taking into account that as noted by multiple researchers (Squire 2006) many youth today spend more time playing in digital worlds than reading printed texts, or watching TV or films, we presume that these virtual spaces are suitable arenas for language learning.

Facing the salient discontinuity between some students' passive learning at school and active involvement in gaming, educators need to create opportunities that may translate students' passion for video games into school learning. Creating opportunities that motivate learners especially in the field of classical languages, such as Latin is a necessity. Learners often face these studies as obsolete and cannot make any connections

with the modern life.

Despite the widespread perception that virtual 3D learning environments can enhance learning there is a lack of an attentive literature review that collects and presents evidence or confutation of this argument. There are very few literature reviews about researches that focus on the impact of 3D virtual worlds in second language learning during the last years. These are poor, they are not systematic and they are not based in a recognized literature review methodology. In addition, the few existing literature reviews are focused on a specific author, country or journal failing to describe pluralistically the field. This paper attempts to overcome these barriers with a complete and detailed bibliographic review that is based on a reliable appropriate methodology.

Moreover, as an attempt to increase students' motivation about learning the Latin language, this dissertation implements a game design model and expects to offer an innovative educational game in the classical studies field, connecting the past with the future. The creation of a collaborative multi player educational game in a 3D virtual space might increase learners' motivation by simulating a roman environment and by offering an immersive experience in a place where the students otherwise would never visit. The designed game follows a comprehensive educational game design and its innovation is that to the researcher's knowledge there is no other game for Latin language learning in a 3D virtual environment. The game created expects to increase learners' motivation.

Concluding, the contribution of this thesis lies: (a) in the gathering and presentation of research that has been conducted to date in the 3D Virtual World language learning sector to facilitate subsequent searches and (b) in the creation of a collaborative multi-player educational game that is based on a systematic game design methodology and on basic principles of second language learning approaches. The game aims to motivate students and complement classroom Latin language learning.

## 1.2. Research scope and objectives

This project has **two main objectives**:

(a)to gain an insight into the emerging research field of second language learning in virtual 3D multi-user collaborative environments through a systematic and pluralistic literature review.

At this point, it is deemed necessary to clarify the difference between purposeful and general purpose virtual worlds. Purposeful virtual worlds are usually related to massively multiplayer online games (MMOGs) such as World of Wordcraft. These worlds have a predefined structure, clear goals and objectives. In contrast to these purposeful worlds , general purpose virtual worlds are designed to facilitate socialization and support user creation of in-world objects. (Wehner, Gump and Downey 2011). Only the investigation of the latter is related to the objectives of this work.

(b)to use previous experience and technology to create an effective collaborative multi user educational game for Latin language learning in a 3D virtual environment for flipped classrooms.

The **specific objectives** are:

- To collect and study scientific articles that focus on the impact of the 3D virtual learning environments in second language learning
- to identify gaps in the literature review and suggest directions for future research
- To explore the potential of the virtual 3D environments and identify possible problematic areas
- To compare  popular 3D platforms

- To adopt and describe a comprehensive educational game design model

The game created is called “Escape Domitian” and is designed on the OpenSim platform. The game can be played by learners of Latin language or by anyone interested in this language.

### 1.3. Structure of the thesis

This dissertation consists of 6 chapters. The first one is the introductory chapter that gives the definition of the problem, the scope and objectives of the study and the structure of the dissertation.

The second chapter presents some popular educational approaches for game design and the key features of the most common used 3D platforms. In addition, it explores innovative practices used by universities, companies and communities of volunteers for second language learning in 3D virtual environments.

The third chapter describes the methodology followed for the literature review and for the game design. The methodology used is adapted to the requirements of the topic.

The fourth chapter reviews the literature about second language learning in 3D virtual environments. The results of the literature review are presented in tables. Key concepts such as the benefits and the problems identified in this type of learning are analyzed.

The fifth chapter refers to the process of the game design. The selected educational approach, the architecture and the technical features of the selected platform and the adjusted and enriched game design model are described thoroughly.

The sixth chapter that is the last one, presents the “Escape Domitian” game and the virtual environment, where the game takes places.

# 2. Related Work

## 2.1. Introduction

## 2.2. Educational game design approaches

An effective educational game design must achieve a balance between fun and educational value (Prensky, 2001). However, some game approaches emphasize on fun and some other on the educational content. According to Moreno-Ger et al.,(2008) integrating games into learning process can be summarized into three approaches: (a)Using multimedia technologies for content presentation for edutainment purpose; (b)repurposing commercial pre- existing games for educational purpose; (c) designing specific games that seek a balance between fun and educational content.

### 2.2.1. Edutainment

The term comes from the combination of the word education and entertainment and is usually used to describe initiatives focused on the educational content. Edutainment games are those which follow a skill and drill format in which players either practice repetitive skills or rehearse memorized facts (Dondlinger, 2007) Fun is added on the top of the learning experience and it's not the main goal. The result is usually not a real game, but a game-style environment or activity.When the entertainment aspects fail to shine in the design, most of the advantages of game-based learning in terms of motivation and engagement are lost and the learning experience suffers (Moreno-Ger, et al., 2008).

### 2.2.2. Repurposing existing games

This category describes initiatives that use commercial, pre- existing games for educational purposes. Despite the fact that these games are not initially developed for learning, their environment and their content are so rich that they can be integrated in the educational process. An example is the integration of the well-known Massively Multiplayer Online Role Playing Game (MMORPG) "World of Warcraft'" in an English

Language class. English language learners train several language skills through raiding, questing, killing and co – solving. (Newgarden, et al., 2015)

### 2.2.3. Specifically designed games

Another approach is designing from the beginning an educational game usually tightly linked to a specific curriculum or learning content. If the game will be applied on other courses, it should be redesigned. Although there are successful stories, this process is time and money consuming (Liu, et al., 2012). However, the result is a game absolutely tailored to the subject and to the learners' needs.

## 2.3. Popular 3D Platforms

Based on our research we found that the most commonly used platform is Second Life. OpenSim comes second and then other platforms such as Active Worlds and Open Wonderland follow.

### 2.3.1. Second Life[2] (SL)

Second Life launched on 2003 by Linden Lab and since then is the most popular proprietary platform. By 2013, according to the last public report, Second Life had approximately 1 million regular users[3] and a large and active educational community. There is also a large user base for event promoters looking for audiences, retail merchants looking for customers, marketers looking for influence, activists looking for publicity and for anyone looking for social networking.

The client/ viewer of SL is open source, free and multi-platform but the server is owned by Linden Lab firm that is the only vendor. All the other available vendors are resellers. This platform has customizable avatars, built-in voice and standard text communication tools (i.e. chat, IM). Another feature is the teleport but is only possible between regions on the Second Life grid. One of the most exceptional capabilities of SL is the in-world building and scripting of the objects.

[2] www.secondlife.com
[3] https://en.wikipedia.org/wiki/Second_Life

The scripting language used is the Linden Scripting Language. Sharing objects among users is also possible. There is also a gigantic web based marketplace with ready-made models and content for free or for sale. The created content can be backed up and there is some content protection policy for content creators. However, Linden Lab allows backup of content that users have created every part of the object. For example, when users create a region including objects that they themselves have created but also objects that other users have given to them, they cannot back up all the region as it is. In addition, Linden Lab can remove individual items from user inventories, entire regions from the grid, or shut down any user account at any time.

Furthermore, SL has its own virtual currency, the Linden dollar, that can be exchanged for dollars or Euros. Users can also make off-grid transactions via PayPal. However, officially, the currency is not actually owned by users but is licensed, and Linden Lab can terminate that license at any time without a refund.

As a commercial platform, SL provides registration and basic usage for free but if the users want to build a home they have to pay a monthly fee for a small parcel of land. The cost of a small parcel of land in order to become resident is 88.56USD per year, the cost of a region or island that is needed for a bigger project (256x256m2) is 1000-1029 USD per year for the setup plus the maintenance cost that is 295USD per month and the cost of a large piece of land in Mainland is 195USD per month. There are also additional costs for uploading objects (Maratou & Xenos, 2014).

### 2.3.2. OpenSimulator[4] (OS)

OpenSimulator often referred as Opensim is a free, open source platform that allows the creation of multi user 3d environments. The OpenSimulator project started in early 2007 as an open source server side to Linden Lab's Second Life open-source client. Consequently, OpenSimulator's current architecture is heavily influenced by that of Second Life. The graphical environment is highly detailed and the avatars are fully and detailed customizable. There is an in-world building tool and the objects created or the

[4] www.opensimulator.org

whole region can be backed up even if the objects were not made from the scratch by the user. The scripting language is the same used in Second Life, Linden Scripting Language and the OpensIM scripting language and C# are used as well. The in-world communication occurs through built-in voice and text communication. Another exceptional feature is the Hypergrid, that allows hyperlinking between Opensim worlds without the need to create new avatar. The client is free, downloadable and compatible with multiple operation systems. The server is free and there is the option for self – hosting a world on own server for free or for hosting on vendor servers. There are dozens of vendors who can offer hosting, consulting, design, development and the prices range from 15USD/month to 100USD/month. (Maratou & Xenos, 2014)

### 2.3.3. Active Worlds[5] (AW)

Active Worlds was launched in 1997.AW can be reached through a downloadable browser compatible with Windows, Linux and OS and is considered to be a very stable server. Visiting Active Worlds as tourist is free and they can build in public spaces. The customization is very basic comparing to the other platforms. There is no inventory as well for saving items. Building cannot start from zero as the users have to copy an already existent object and modify it. This platform also supports imports from popular 3D design programs such as Blender. In addition, it loads faster and it is easier to learn. However, the scripting and the building features comparing to the others platforms are basic, the graphical design is very easy but poor and the avatars look very unnatural and robotic. There is also back up possibility, self-hosting and multiple vendors for that. AW also has a voice and text chat feature, instant messaging (called telegrams), a built-in contact list and multi-lingual support. Currently, there are over a thousand different worlds in the AW universe.

The server is downloadable and can there is a possibility for self-hosting. The cost for the basic License is 69.95USD (onetime fee) and there is also an annual registration fee (depends on No. of avatars & size of region) starting from 59.95USD to 650USD per year. (Maratou & Xenos, 2014)

[5] www.activeworlds.com

### 2.3.4. OpenWonderland[6](OW)

OpenWonderland is an open source free 100% JavaTM toolkit for creating 3D collaborative virtual worlds from scratch. The platform is available for use at no charge and any part of the system (client or server) can be both further extended and modified. As for clients, Open Wonderland worlds can be accessed via a URL. To start, the client uses Java Web Start technology, i.e. all required data is downloaded from server's web page; the client application is then started on the client machine using local Java software. OW does not offer in-world 3D building, but supports the use of most open source and commercial 3D modelling tools such as Google Sketch Up and Blender. Object within the virtual environment can be arranged, e.g. moved, resized, using in-world tools. A distinct feature of Open Wonderland is the ability to easily bring in existing content. The list of document types that can be dragged and dropped into the world include a shared whiteboard which multiple people can draw on at the same time, sticky notes for brainstorming and a multi-user PDF Viewer for browsing slides independently or in sync with a presenter. Also, OW does not support avatar's inventory. Within OW worlds, users can communicate with high-fidelity, immersive audio, share live desktop applications and collaborate in an education or business context (simulations, meeting rooms, mixed-reality worlds, etc.).

## 2.4. Practices using 3D educational games/activities for second language learning

The goal of the research was to detect any educational games or game style activities used especially in language learning in the virtual worlds. The review was based on published researches related to the topic. However, the research uncovered that none of the educational projects could be found online. In order to get a general idea about the 3D virtual environments for language learning we extended our research to the online virtual worlds found in the directories of the most popular 3D platforms, such as Second Life

[6] www.openwonderland.org

and OpenSim. We visited and explored a variety of educational environments focused on language teaching and learning.

In the following, some representative examples are presented and evaluated regarding their pedagogical value.

### 2.4.1. Global classroom

In February 2010 Lingnan University in Hong Kong approved the development of a virtual world teaching resource for undergraduate studies by the Teaching and Learning Centre (TLC) of the University. Working in conjunction with the Centre for English and Additional Languages (CEAL) department, the TLC developed the Global Classroom language-learning activity as an Independent Learning component of the CEAL English as a Second Language (ESL) first-year courses. (Knutzen and Kennedy, The Global Classroom Project: Learning a Second Language in a Virtual Environment 2012)

Students were given a wide range of activity choices for their Independent Learning component, which made up 20% of their course grade. The Chinese students were taught English as a Second Language by American students from the Texas A&M University (TAMU) in the US through a partnership between the two universities. The Global Classroom consisted of a series of hands-on workshops held two or three times a week at language computer labs from 7 to 9pm, over the months of September and October in the 2010/11 school year and about 120 students from the two universities participated. Students and teachers were trained prior to the use of the platform.

The language activities were set up on the Second Life platform. Several settings were developed on three virtual islands. A wide range of virtual activities aimed to stimulate possible conversational scenarios between language learning partners.

The most popular area for socializing was the “Caddy Shack”. This environment has the look and feel of a 1950's-era American diner, with a large bar and restaurant seating area, rotating dance floor, and 12 classic convertible Cadillac cars. There the students could simulate the social activities of serving and drinking various beverages, dancing, playing

mahjong and billiards.


**Figure 1: The Caddy Shack diner on Lingnan University Island**


**Figure 2: Global Classroom students IM chatting in a Cadillac diner booth, while two students dance on the rotating dance floor in the background**

Also, virtual trips to New York city, Mauritius Island, the pyramids in Egypt, and Paris in 1900 were scheduled. These trips provided a range of novel experiences which are typically not available to most students: living homeless on the street, driving a horse-drawn carriage, going for a ride on a giant dodo bird, and posing for snapshots atop the

Great Sphinx of Giza.

**Figure 3: Riding horses is a popular activity on the Lingnan University Island**

In terms of modelling the environment created is really interesting. The graphs and the simulations can attract the students' attention and can give a sense of immersivity. There are also interesting integrated tools such as a translator and a YouTube media player. However, asking from students to enter a 3D virtual environment and talk it is not enough to keep their motivation for a long time. It is remarkable that only the 20 % of the initial number of learners continued attending the workshops to the end. This might be related to some critical factors: The whole attempt lacks of any instructional and pedagogical framework and no game model design is applied. As a result, there are no clear learning objectives, no guidance or instructions, no scenario, no roles assigned to each student. The dialogues between the students were freely flowing conversations without any specific goal.

### 2.4.2. VirtUAM

The University of Madrid developed on the OpenSim platform an environment for language learning using interactive 3D online games. From 2012 to 2013 several researches were made on this environment. According to the researchers' results (Berns, et al., 2013; Garrido-Iñigo & Rodríguez-Moreno, 2013; Gomez, et al., 2013;Gonzalez-

Pardo, et al., 2012; Gonzalez-Pardo, et al., 2013; Palomo-Duarte, et al., 2012;Palomo-Duarte & Berns, 2013;) 3D virtual environments have a positive impact on learners' performance and motivation. The pedagogical framework applied is considered to be based on the cooperative and constructivist principles. The target groups were students of German and French language. The first two games described are the "Shopping-game" and the "Hidden room-game".

In the "shopping -game" levels 1 to 3 provide students with rich language input ranging from vocabulary, grammar, listening, reading, writing in order to prepare them for the final game in level 4. (Gonzalez-Pardo, et al., 2013)

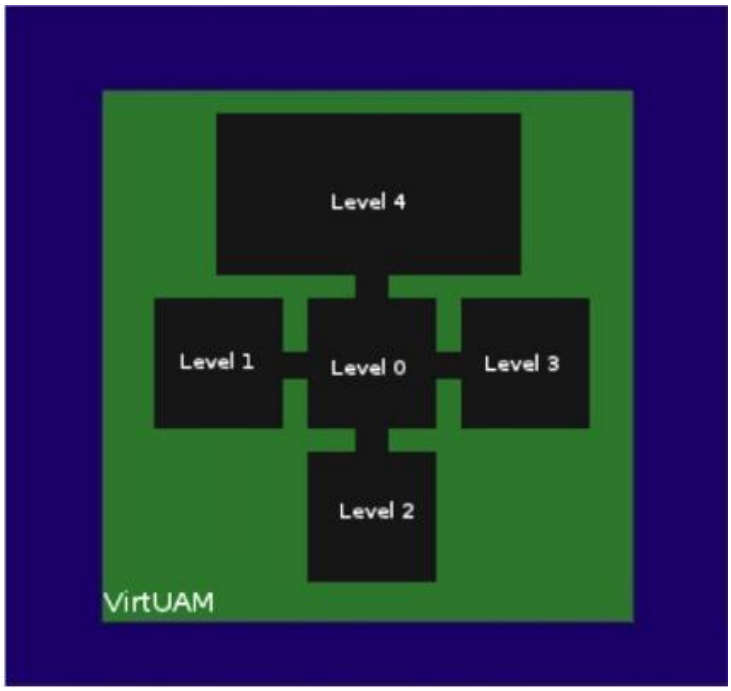



**Figure 4: Map of the supermarket game**

In level 1 the vocabulary is introduced to the students by means of photos in combination with audio recordings. The second level provides a quiz-like activity to be performed in teamwork, competing with two other teams. The goal is to test the students' listening skills acquired in the first level. In level 3 there is a quiz played by each player individually but through competition with other players.

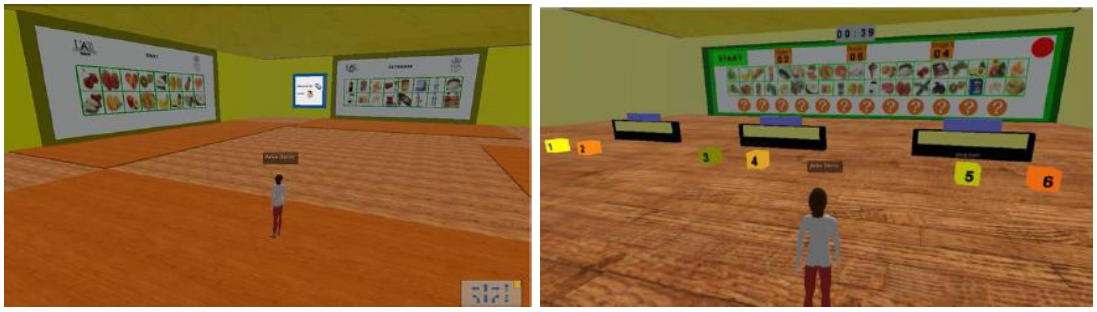


**Figure 5:Training Room in level 1 and Quiz room in level 2**

Unlike level 1 to 3, level 4 is based on a role-play and requires students to collaborate on a shopping-task in an electrical-shop. One student takes the role of a customer and the other performs the role of a shopping assistant. The system displays several shopping lists on the customer's screen. The shop-assistant has to fill in the trolley with the products that the other player asks him to buy.


**Figure 6: Virtual Shopping, level 4**

According to Berns' (2013) description, the "Hidden room" consists of two levels. The first level aims to introduce the use of local prepositions through a game-based activity, called Memory and can be performed solely individually. By clicking on the walls of the room the learner receives through image, text or audio file several sentences that describe pairs of objects in the room. The students' task is to match the correct pairs. Once the students have matched a correct pair they get a score. There is also time limit and

feedback about student's performance.

The second level, called the hidden room, aims to reinforce the previously introduced prepositions through a role-play activity and needs to be performed cooperatively. The second level is therefore based on a room which contains a number of different objects: clothes, furniture, food, beverages, toys and electronics. These are placed all over the room and need to be put in their correct position reconstructing the original room order. As the activity requires the cooperation of two players, two different game tools were designed: a controller and a viewer with different views of the room. At the beginning of the game the teacher or administrator provides each player with a different tool. In order to perform level 2 cooperatively player A gets a" controller" that enables him/her to move the objects within the room (see Figure ) and player B gets a viewer with several views of the room (see Figure ). Furthermore, in order to reconstruct jointly the correct position of each object, players A and B need to communicate only by using the text chat.

**Figure 7: View of player A and view of player B**

Another research in the same virtual environment was conducted by Garrido-Iñigo & Rodríguez-Moreno (2013). The OpenSim platform was tested as a tool in teaching French to 108 tourism students at Universidad Rey Juan Carlos in Madrid. The prototype is presented as a game in which it is necessary to pass a series of tests and a contest in which there will be three winners. This island recreates an airport. There are check-in desks, an arrivals area, a departures area, boarding gates, a luggage pick-up area, an information point, vending machines providing drinks and food, a VIP lounge, duty-free facilities, a runway and toilets.

All the objects show their name in French when the pointer is placed over them. The learners interact with several objects in the airport area that produce common written conversations in an airport area in order to recall these dialogues, that they have already learn in the classroom. In the next level the students take a multiple test, displayed on their screens, and based on the previous dialogues.


**Figure 8: Taking an Individual test**

During the final level, they are separated in groups of 3 people and competing the other teams are trying to complete the missing sentences on a dialogue appeared on a board. They communicate through text chat.

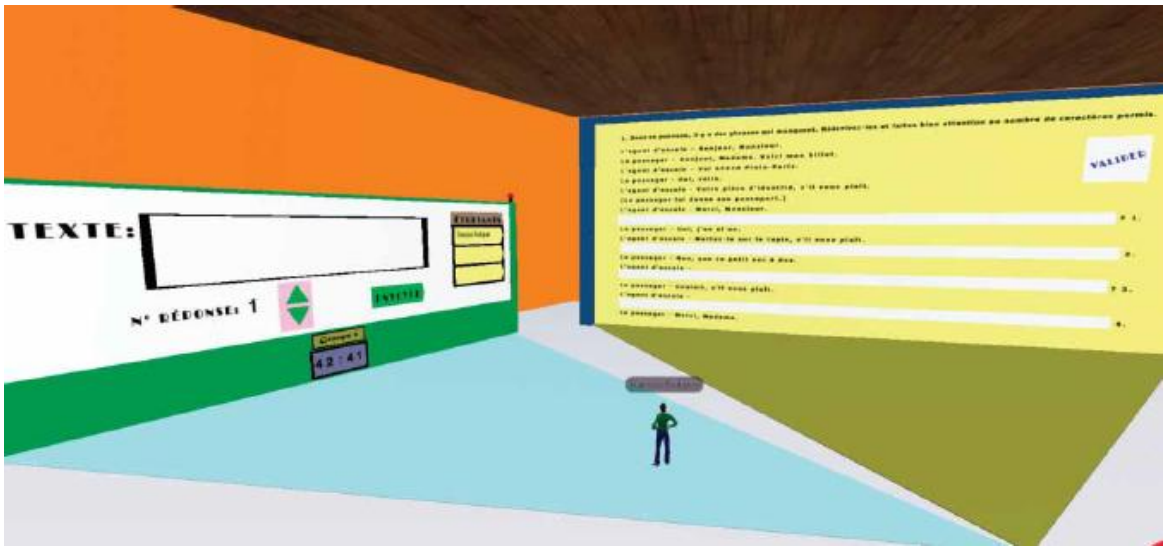


**Figure 9: Completing the missing sentences on the board**

In terms of the instructional framework followed, all the games are well organized around the constructivist principles. Knowledge is constructed step by step, from level to level. The first two games provide opportunities to practice equally writing, listening, reading and speaking skills. However, only the final level of each game justifies the use of a 3D learning environment. The first levels are static, make no use of the 3D environment and could easily be played on a 2D environment. The final level especially of the "shopping" and the "hidden room" game provides interaction between the learners and between the learners and the environment as well, that make the game more interesting, immersive and interactive. A negative point is that the supermarket role-playing game presented lacks of innovation and creativity, as tasks like that are repeatedly appear in the literature. For example, the shopping game was presented earlier for English language learning by Milton, et al., (2012). As for the third game, the whole concept do not justify the use of a 3D environment. The activities are mainly developed around a board and a multiple answer quiz. The learners do not benefit of the 3D virtual environment so much as they do not need to move their avatar at all. As a result, immersivity is under question.

### 2.4.3. Vill@ge

The study conducted in this environment took place in the School of Arts of Swansea University ( Swansea, UK ) as part of the European-funded Lifelong Learning project entitled Vill@ge and was published in 2012. (Milton, Jonsen, et al., Foreign language vocabulary development through activities in an online 3D environment 2012) The project involved the creation of a language-learning environment on the Second Life platform for two different types of users: young primary school-age learners and university-level adults.

For primary-age learners a virtual island surrounded by virtual sea, was created. The access to the island was restricted and controlled. In this environment locations, such as a supermarket, a clothes shop and a virtual museum were created. An example of how language interaction was integrated into the Vill@ge environment is provided by a shopping task in the island's supermarket. For this task a learner was given the task of

shopping with a native speaker. The native speaker had the shopping list and told the learner what to buy, while the learner had the shopping basket and had to fill it with the items needed. When the name of an item was not known then pointing and naming was used to make the name clear. The learners from Greece and the UK carried out the tasks in both Greek and English as a foreign language (EFL).


**Figure 10: Shopping task in the supermarket environment**

The adult learners were students at Swansea University in UK and Szeged University in Hungary. During the course of the sessions the students were paired up (that is, Swansea University–Szeged University pairs) and were asked to converse in English and Hungarian, carrying out pre-planned and loosely structured conversational tasks. For these learners, virtual banks, travel and estate agencies, and show homes were constructed. In these locations learners played several roles. For example, they took the role of a bank assistant who dealt with a customer avatar who, within the role-play were trying to open an account.

**Figure 11:The bank environment**

The environment used in the Vill@ge project seems to be an attractive one. Among the positive characteristics of this environment is the variety of the settings, the pre-planned tasks, that give guidance to the learners. However, it is not clear what instructional framework is applied, if any and there is no direct interaction with the environment itself apart from the shopping task. Finally, the environment is not an innovative one as there are many other similar settings for role playing.

### 2.4.4. Escape[7]

This sim is actively used to teach a Spanish class at Glendale Community College in Arizona and was developed by Dr. James T. Abraham, who has been a residential faculty member at Glendale Community Collegraham since 1998. The virtual environment can be found on the Digiworldz grid, that is built on OpenSim platform. It is open for use by anyone on the Hypergrid. It may be used for self-instruction, as an instructional environment for classes, as a source of ideas for other instructors of Spanish, or as a demonstration for others seeking support for 3D language instruction.

[7] http://jtabraham.org/escape/yourguides.aspx


**Figure 12: Panoramic view of the Escape environment**

Escape environment transports students to Escape, a town in the Spanish-speaking world, that includes a plaza, cathedral, cultural pavilion, school, café, bakery, clinic, transportation hub, bank, travel agency, pharmacy, dry cleaners, traditional house, amusement park, stores and a mysterious pyramid. Each of the locations contains embedded activities designed to teach grammar concepts and vocabulary, practice those concepts and vocabulary and finally test the comprehension. The activities include audio, text, video. Many of the activities are delivered through NPCs (non-playing characters/robot) that use artificial intelligence. Each object typically contains one Aprender (Learn), one Jugar (Play), two Prácticas (Practice) and two Examen (Exam) options.


**Figure 13: Example of interactive exercise**

Escape covers a wide range of basic grammar and vocabulary topics. The environment is also supposed to be used for role playing games and cultural events. Escape is a really attractive and rich environment with different settings and many objects for interaction. A huge variety of grammar exercised can be practiced through interacting with objects or robots. The pictures above show two examples of these types of interaction. The first one presents an activity in which the learner should click on the dove with the right ending for the plural of the given noun. The second one presents some non-player characters who can construct a basic dialogue with the user.


**Figure 14: Choosing the right grammar ending by clicking on the right dove**


**Figure 15: Interaction with non-player characters**

.

Escape is a very rich environment with a wealth of objects and NPC's that cover a wide range of grammatical topics. There is also a variety of attractive and detailed scenes. The environment is appropriate for autonomous learning with or without the presence of the instructor. However, the pedagogical approach behind this environment seems to be the behaviorist approach. As a result, the majority of the activities provided are grammar centered repetitive drills. The learner practices on grammar topics and receives feedback on his/her performance. There is no context or scenario to boost immersivity. Additionally, there are no collaborative activities that would be meaningful in a multi-user platform like this.

### 2.4.5. Edunation Islands[8]

The EduNation islands are focused on the potential of Virtual Worlds to enhance the language learning process. The free services their owners provide include holodecks, teacher meetings and participation at events and conferences. The platform is available online in the Second Life world. The "Start Living English as a Second Language" (SLESL) language school in USA makes use of this platform. However, the school has its own platform as well. Edutopia[9] is a commercial virtual world built to allow synchronous and asynchronous learning of English. Originally started in Second Life but now can be found in Kitely, in the OpenSim platfrom. It includes over 40 mini environments melded together However, all the following examples, presented on the school's website, take place in the platform of EduNations in Second Life, that is used by the language school.

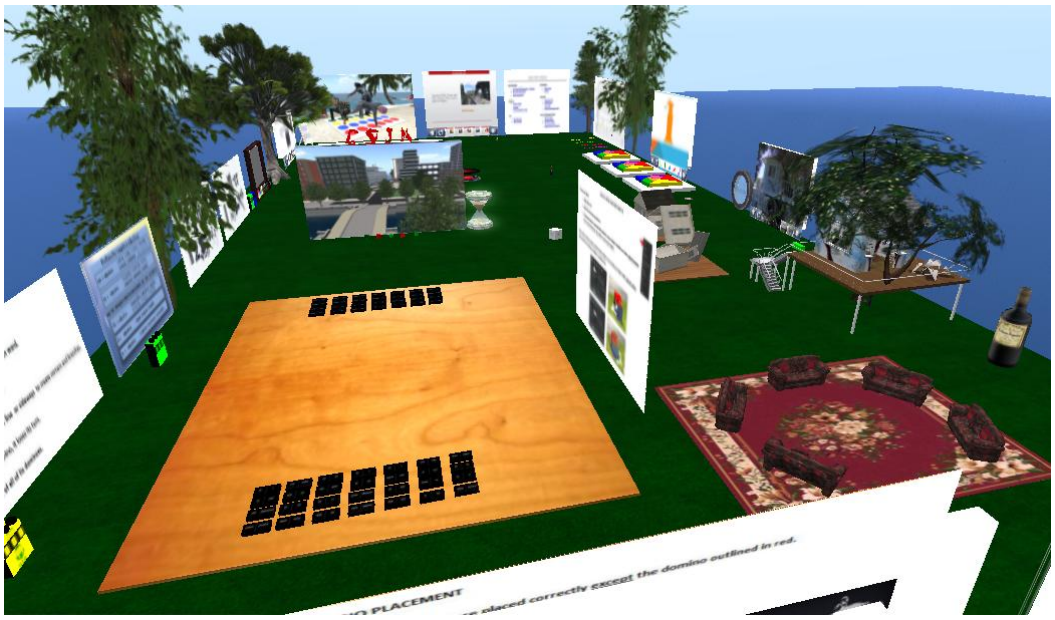


**Figure 16: The Edunations Island**

According to the information retrieved from the school's website the school follows the flipped learning approach. Vocabulary and grammar are studied at home and class time is devoted to activities that promote doing through several activities. The students work in pairs to reassemble a tree house while the students alternate giving and reacting to each other's instructions. This is a way to use the imperative by practicing in giving and

[8] http://edunation-islands.wikispaces.com/

[9] http://slesl.net./about.html

clarifying directions in a very natural way. Students are placed into teams to play a traditional game, dominos. The traditional domino surfaces have been replaced with word roots, prefixes and suffixes. They move in turns the “bricks” in order to create a domino with existent words. They also perform roles around mysteries. The students investigate each other and wander around the scenery and interact with the environment trying to figure out what happened. Besides this, the learners practice on altering their appearance by doing virtual Shopping. They also work on word charts filling the spaces with the right words. Another activity is to perform theatrical performances through their avatars, wearing the appropriate costumes and being in the related setting. The figures below present representative snapshots of the activities.

**Figure 17: Reassembling a tree house following instructions**

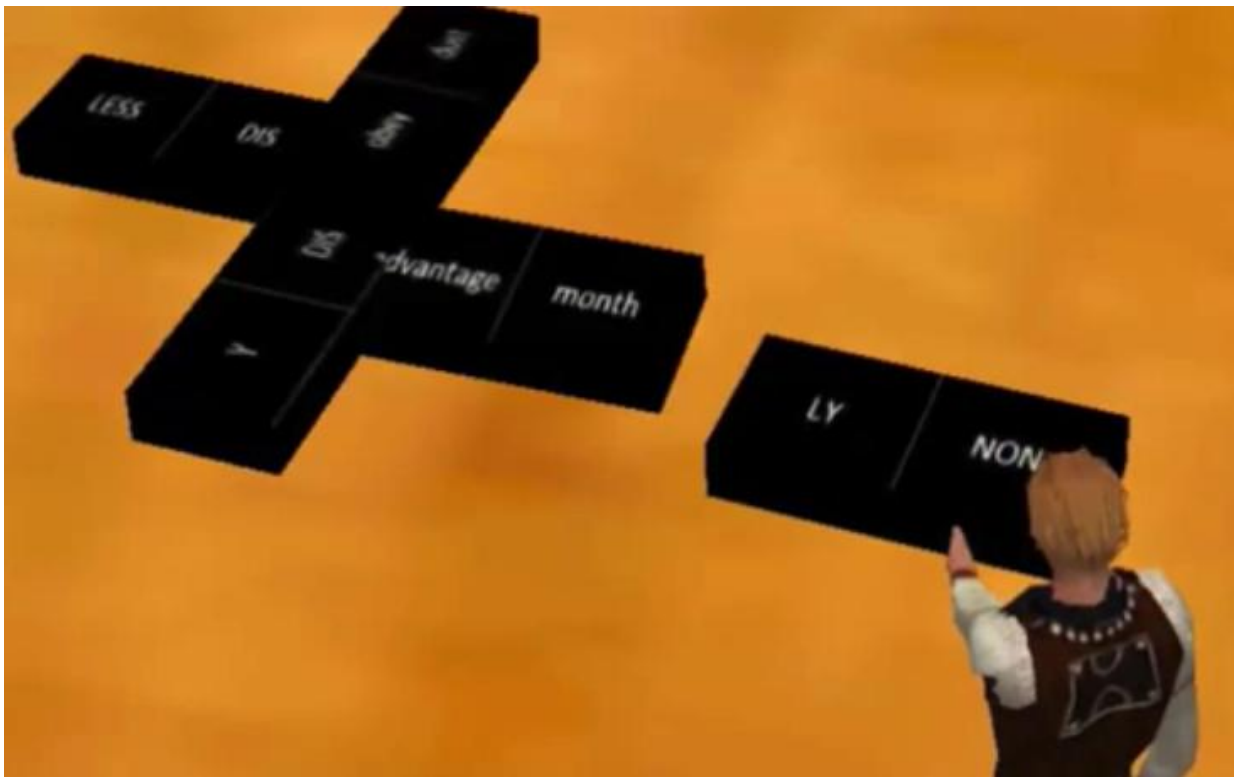



**Figure 18: The domino activity “bricks”**


**Figure 19: The domino activity**

**Figure 20: Investigating a suspect**

‘


**Figure 21: Doing virtual shopping**

**Figure 22: Matching and moving the bricks in the word chart**

This environment seems to be very attractive and immersive. The role playing games that are based on scenarios, the activities that make use of the physical space and the collaborative, multi-user activities create a very positive ground for language learning in a 3d environment. Especially, tasks like “reassembling the house” that combine movement with language production are really interesting and promote immersivity. However, the exclusive instruction in the 3D environment it might be sometimes tiring and boring as there are activities, that are based on static boards and do not really require a 3D environment (e.g. the word chart and the domino).

### 2.4.6. Edmondo[10]

The project " Edmondo "is an environment developed by the ' National Agency for the Development of Education" (INDIRE) of the Italian Ministry of Education. The virtual environment is built on the OpenSim platform. The access is free but restricted. Only Italian teachers and students can access the environment and they can use it for free. The environment provides settings and activities for several subjects apart from languages.

[10] http://www.virtualworldsmagazine.com/tag/edmondo/

As the access to this environment is not possible and in an attempt to explore educational activities on 3D virtual environments we retrieved some information about this environment and the activities that can take place through the annual workshop for English language instructors that takes place on “Edmondo” since 2000. The workshop aims to the creation and integration of games in the teaching process. The overall goal of the so-called workshop Electronic Village Online[11] (EVO) is to provide free online professional development in a collaborative setting to teachers of English as a second or foreign language. It was created in 2000 as a Special Project by the Computer-Assisted Language Learning Interest Section (CALL-IS) of Teachers of English to Speakers of Other Languages (TESOL)and is represented on the Steering Committee of the CALL-IS. EVO moderators and trainers are all volunteers, and EVO maintains its volunteer and non-commercial nature. The figures below show some examples of the 2016’ workshop[12].


[11] http://evosessions.pbworks.com/w/page/114698080/Mission-of-EVO
[12] https://gaming.youtube.com/watch?v=V7SUG4KXFts

**Figure 23: Several Board Games**

**Figure 24: A maze game**

The whole attempt and the initiative are really interesting. The activities created in Edmondo show that environments like this can boost creativity. However, the majority of the games do not make use of the potentials that a 3D environment as Edmodo offers. The board language games can be boring for the students as they do not provide any sense of immersion and can be easily transferred in a 2D dimensions platform. Walking and moving with the Avatar is not required. The virtual space is not utilized. In contrast, the maze game is much more motivating and can promote the sense of immersion as the learner has to walk around the labyrinth and interact with objects in it. The negative point of the labyrinth game is that it does not promote collaboration and team working, that are basic attributes of a 3D multi user virtual environment.

### 2.4.7. Virtatlantis[13]

Virtatlantis is a free language learning resource and community of practice in the virtual

[13] http://www.virtlantis.com/

world of Second Life. Inside the Virtatlantis environment are offered weekly activities for practicing English, French, German, Polish and Spanish. The environment was created by volunteers and since 2006 offers activities organized by volunteer language instructors. The activities are open to the public and free of charge. All costs are paid for by donations as well as financial sponsorship from the Oxford School for English, a language school with locations in Austria and Germany.

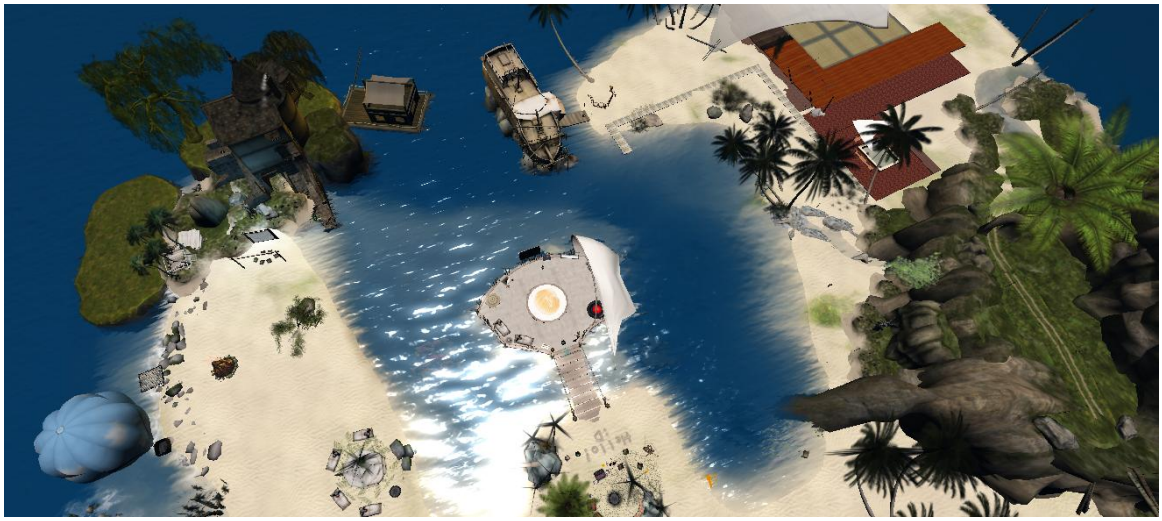


**Figure 25: Panoramic view of Virtatlantis island**

After logged in and teleported to Virtatlantis the language learners can explore a virtual island with the relevant settings. They can also find a virtual calendar at the info point located in the middle of the island. This environment is not so rich in terms of scenes / settings and there is no interaction with the environment. There are no interactive objects or NPC's. As a result, the effectiveness of the environment is based absolutely upon the activities and the events that will be organized by the instructor.

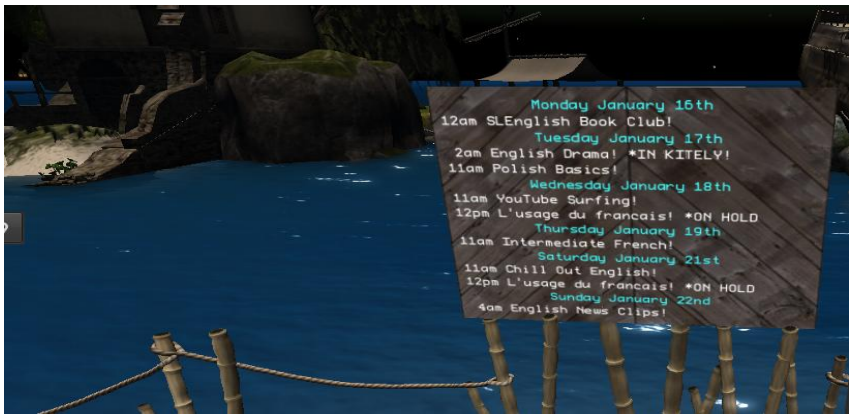



**Figure 26: Calendar showing the pre-scheduled activities**

### 2.4.8. Overview of the 3D virtual environments

Table 1 summarizes the basic characteristics of the aforementioned 3D virtual environments and the language activities that take place in the them. The table presents the name of the environment, the use of the environment, the type of the activities that take place in it, its special features and whether it is available and accessible or not.

**Table 1. Overview of the virtual environments and the activities**

| Name | Type of use | Main activities | Special Features | Availability | Accessibility |
|---|---|---|---|---|---|
| The global classroom | Research | Role playing, Virtual tours, Sport activities | embedded translation tool Embedded YouTube player | Not found online | Restricted: only the students and the teachers participating in the research are allowed |
| VirtUam | Research | Role playing, Quiz, Matching words with images | Embedded audio files, score system, time limit, Feedback control and viewer tools | Not found online | Restricted: only the students and the teachers participating in the research are allowed |
| Vill@ge | Research | Role playing | - | Not found online | Restricted: only the students and the teachers participating in the research are allowed |
| Escape | Open Educational Resource | Quizzes, Guided Dialogues | NPC's, Interactive objects, Embedded links | Online, OpenSim grid | Free, Open Access |
| The EduNations Islands | Commercial | Matching objects with images, Virtual Shopping | Interactive objects | Online, Second Life grid | Free Open Access with restrictions |
| Edmodo | Open Educational Resource | Board games Simulations Role playing games | Embedded Multimedia files | Online, OpenSim grid | Free Open Access with restrictions |
| Virtatlantis | Open Educational Resource | Role playing | - | Online, Second Life grid | Free, Open Access |

## 2.5. Conclusions

Taking into account that a virtual environment is a 3D- multi user-collaborative environment we expected to find a game or an educational activity that would make use of these features. However, after reviewing a variety of environments and activities we conclude that there is not any designed language collaborative, multi-user game that

makes effective use of the 3D virtual space. Apart from the role playing games, the activities that are multi user and collaborative are tasks and not games (e.g. virtual shopping, co-building etc.). The few activities that are closer to the logic of a game (e.g. maze game) are not played collaboratively but independently.

In addition, the educational games and activities found do not always make full use of the potential of a 3D environment. Even if they are impressive at first sight they possibly do not manage to keep the learners engaged and motivated in a longer period of time. The majority of the activities presented do not justify the use of 3D environment as they can easily be transferred into a 2D environment. Even if they aim to promote immersivity this is not always achieved, especially when they make use of static boards, in which movement of the Avatar is not really needed. Furthermore, most of the educational activities are very focused on the modelling and lack of a pedagogical frame. Additionally, there is not always innovation. Similar activities such as the shopping task and the role playing games are often repeated. Finally, some educational activities are presented as "educational games" while they do not have the attributes that an educational game is supposed to have.

# 3.Methodology

## 3.1. Intro

This dissertation has two clear objectives: a) to map the new field of second language learning in a 3D MUVE and to b) suggest an effective 3D collaborative game for teaching and learning Latin, appropriate for flipped classrooms. In order to meet the two objectives, this project is based on two corresponding methodologies: a literature review methodology and a game design methodology that are presented in the following sections.

## 3.2. Literature Review Methodology

In order to conduct a literature review related to the emerging topic of the virtual 3D collaborative multi user online learning environments used in second language learning, it is essential to apply a systematic literature review methodology. This chapter describes

the approach followed to determine and structure the source material for the review as per proposed by Webster and Watson (2002).

### 3.2.1. Identifying the relevant literature

Webster and Watson (2002) provide a step by step structured approach for identifying key sources of information.

a. It is reasonable to start the literature search process with the leading journals. The fastest way to access relevant articles is to search through the journals database using keywords. However, it is useful to scan journal's table of contents to avoid the risk of missing important articles that escaped the keyword sieve. The researcher should also examine selected conference proceedings of high quality. Going further, the journal research should not be confined only in Information Systems discipline, considering that the Information Systems discipline is an interdisciplinary field.

b. After identifying the articles, the researcher should review the citations for these articles and determine prior articles that might be included in the review. Proceeding, the database of Web of Science is used for the identification of articles citing the key articles identified in the previous steps.

c. A systematic literature review has almost reached the end when new concepts are not anymore identified in the article set. Of course, some articles will be missed but if they are critical they might be pointed out by other colleagues.

### 3.2.2. Structuring the literature review

The structure of a literature review depends on the approach followed regarding the concept. The author-centric approach that presents a summary of the articles is rejected as is insufficient to synthesize the literature. In its place, a concept-centric approach is recommended.

**Table 2. Approaches to Literature Reviews**

| **Concept-Centric** | **Author – Centric** |
|---|---|
| Concept X… [author A, author B] | Author A…concept X, concept Y… |
| Concept Y… [author A, author C] | Author B…concept X, concept W.. |

The latter requires the construction of table, an idea which was introduced in a similar form in Salipante et al. (1982). This table is called a *"concept matrix"* and it has to contain a column which corresponds to every article that has been chosen. The columns on the right of the first one indicate the different concepts which have been identified in the articles. The marks in the blocks indicate the certain concept around which each article is developed. The general form of the "concept matrix" is given below:

**Table 3. Concept Matrix**

| Articles | Concepts | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | A | B | C | D | E |
| 1 | × | | | × | |
| 2 | | × | × | × | × |
| … | | | | | |

When the reading is complete the literature is synthesized by identifying, grouping and presenting each different concept.

In some cases, in order to have a better understanding of the literature and handle the unit of analysis, it might be useful to add one more dimension in the table. This dimension introduces different cognitive utterances of the same concept. A concept can have different meanings when is examined from different point of view (Te'eni ,2002). The approach based on the so called "Concept matrix augmented with units of analysis" results in a more complete review because it is easier to detect when a concept strays out of the concept of its domain.

**Table 4. Concept Matrix with Augmented Units of Analysis**

| Articles | Concepts | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | | | B | | | C | | | D | | | E | | |
| Unit of analysis | X | y | z | x | y | Z | x | y | z | x | Y | z | x | y | z |
| A | | | × | × | × | | × | | | | | | | | × |
| B | | | | | | | | × | × | | × | | | | |
| … | | | | | | | | | | | | | | | |

Tables and figures can be an effective means of comprehending and presenting the literature around a topic. However, they need to add value and not to be merely a list of articles. The articles should be categorized based on a scheme that sheds light to the findings, to any gaps of the literature and to the types of the variables examined or other theoretical issues.

### 3.2.3. Adopting formal writing style

Furthermore, it is emphasized that a literature reviewer must not be overly critical of previous papers but must respect the work of those who labored to create the foundation of the current work by keeping in mind that all research is flawed (McGrath, 1982). A review should identify any patterns in the literature, present the accumulated knowledge and uncover any gaps for future research. In the event that a paper refers to a research which was poorly conducted and lacks of scientific methods, it is advisable to omit it.

An additional element is the tense used in the review. The present tense is more preferable because it creates a sense of immediacy towards the reader, it helps the reader to grasp easier the meanings and finally it better adheres the context of the "concept-centric" approach, as a concept is always here and now. The only exception in this recommendation is when attributing a statement or idea to a person, who might not express the same idea or statement any more. In this case the author should opt for the

past tense.

### 3.2.4. Summary

Webster and Watson (2002) suggest a framework for determining, analyzing, structuring and categorizing the literature review. The papers should be analyzed based in core concepts and categorized following a framework. A literature review should not be limited to one research methodology, focused on a specific set of publications, such as the "top" journals, and restricted by geographical boundaries.

A successful literature review gives the other scholars the accumulated knowledge on a topic and presents the key findings by structuring the central concepts around a central idea and by making effective use of tables and figures. Summarizing, Webster and Watson recommend that an ideal article:

- motivates the research topic and explains the review's contributions
- describes the key concepts
- delineates the boundaries of the research
- reviews relevant prior literature in related areas
- develops a model to guide future research
- justifies propositions by presenting theoretical explanations, past empirical findings, and practical examples
- presents concluding implications for researchers and managers.

And on top of this, the exemplary review article should be explanatory and creative.

## 3.3. Game Design Methodology

### 3.3.1. Selecting educational game design approach

In section 2.2 three very popular approaches were described: Edutainment, repurposing existing games and specifically designing games. One of them will be selected and applied for the creation of our educational game.

### 3.3.2. Setting criteria and selecting platform

In section 2.3. we presented the most commonly used 3D platforms: Second Life, OpenSim, OpenWonderland, Active Worlds. In this step, we are going to set criteria, compare the platforms and select the most suitable for this project. The platform of selection will be described thoroughly.

### 3.3.3. Selecting game model design

In this step, we are going to review the literature and find an appropriate game design model, in order to develop an effective educational game. If necessary, the model will be modified and adjusted in order to meet the requirements of the game.

### 3.4. Summary

Summarizing, in order to meet the objectives of this project we follow the steps of two corresponding methodologies. At first, we are going to apply Webster's & Watson's (2002) literature review approach. Based on this, we follow a framework for determining, analyzing, structuring and categorizing the literature review. After mapping the emerging research field of second language learning in 3D MUVEs we are going to design an educational game for learning Latin. In order to do so, we will follow a game design approach, then we will select and present an appropriate 3D platform based on the criteria we will set, and finally we will choose from the literature a game design model which we will modify if it is deemed necessary.

## 4. Literature Review Methodology

### 4.1. Introduction

The literature review presented applies the Webster and Watsons' (2002) literature review approach that was described in section 3.2. The methodology followed is tailored to the topic of Second Language Learning in 3D Virtual Collaborative Multi-User Learning Environments (SLL in 3D MUVE's). We do not aim to test specific hypotheses but rather to map this new field. For this purpose, we base our work on examining multiple case studies identified from published literature that use 3D virtual learning environments for second language learning.

The relevant research papers are detected using specific keywords in a variety of scientific databases. We searched different combinations of these keywords and phrases: “multi user virtual environments” and “MUVE”, “second language learning”, “ foreign language learning” , “ three dimensional” and “3D”, “virtual world”, “metaverse”, “multi-user”, “collaborative”, “avatar”, “second language acquisition” and “SLA” “second language and “L2” , “interactive”, “environment”, “classic”, “Latin” within online general databases such as Web of Science, Scopus, Google Scholar, CiteSeer, Science Direct and Taylor and Francis online. In addition, as the major contributions are likely to be in the leading journals related to technologies used in language learning, the search was also conducted in specific journals databases such as , ReCALL , which is the main publication of EUROCALL and it is published by Cambridge University Press. Scanning a journal’s table of contents is a useful way to pinpoint other papers not caught by the keyword sieve.

The search resulted in the identification of numerous relevant articles that were further reviewed. This led to a sequential investigation of their references, which resulted in a second round of literature review and the collection of additional articles. The above searches resulted in 128 published articles in total. After reading the abstracts it was found that several of the articles were not within the specific field of knowledge, and thus rejected and some other articles were not publicly accessible, thus they are not included in the present work.

For the selection of the articles a set of criteria was implemented. The articles selected were published in scientific journals or conference proceedings and are written in English language. Articles published before 2005 were also rejected as we consider that the rapid evolution of technology makes them obsolete. Articles that didn’t include an experiment and results were also rejected. Finally, articles associated to purposeful virtual worlds, such as massively multiplayer online games (MMOGs) that include games such as World of Warcraft and Everquest were rejected. Finally, 32 cases were selected.

These cases are categorized and structured based on the concept-centric approach. In order to make the transition from author- to concept-centric literature review approach, a

concept matrix is compiled while reading the articles. The organizing framework of the review is based on the identified concepts. Tables are used as an effective mean to categorize the articles and communicate better the major findings. The concept matrix compiled includes the most important concepts identified in the papers such as the type of activities that take place in the 3D virtual environments, the benefits and problems identified, the tools used etc. The concept matrix is shaped as above.

**Table 5. Concept Matrix for Language Learning in an online 3D Virtual Multi User Collaborative Environment**

| Cases | Approaches | Tools | Activities | The instructor's role | Benefits | Problems | Learning type | Thematic research focus |
|---|---|---|---|---|---|---|---|---|
| C1 | | | | | | | | |
| C2 | | | | | | | | |
| ….. | | | | | | | | |
| C32 | | | | | | | | |

After structuring the literature review we aim to examine the 32 representative cases where 3D MUVE's have been used for second language learning and we carry out an analysis of each case. We aim to research:

1. Are these environments used for blended or for synchronous learning?
2. What it the most and what is the least explored topic?
3. What is the teaching approach applied?
4. Which tools and activities are most used?
5. What is the instructor's role?
6. What benefits and problems were encountered?
7. What is the participant's' profile?
8. Are they used as complementary or as exclusive educational tools?

### 4.2. Overview of the cases and research profile

The table above attempts to give an overall overview of the literature review. The selected cases are structured in a table that includes the author's name, the target language, the platform used, the country of the research, the publication year and the type of publication.

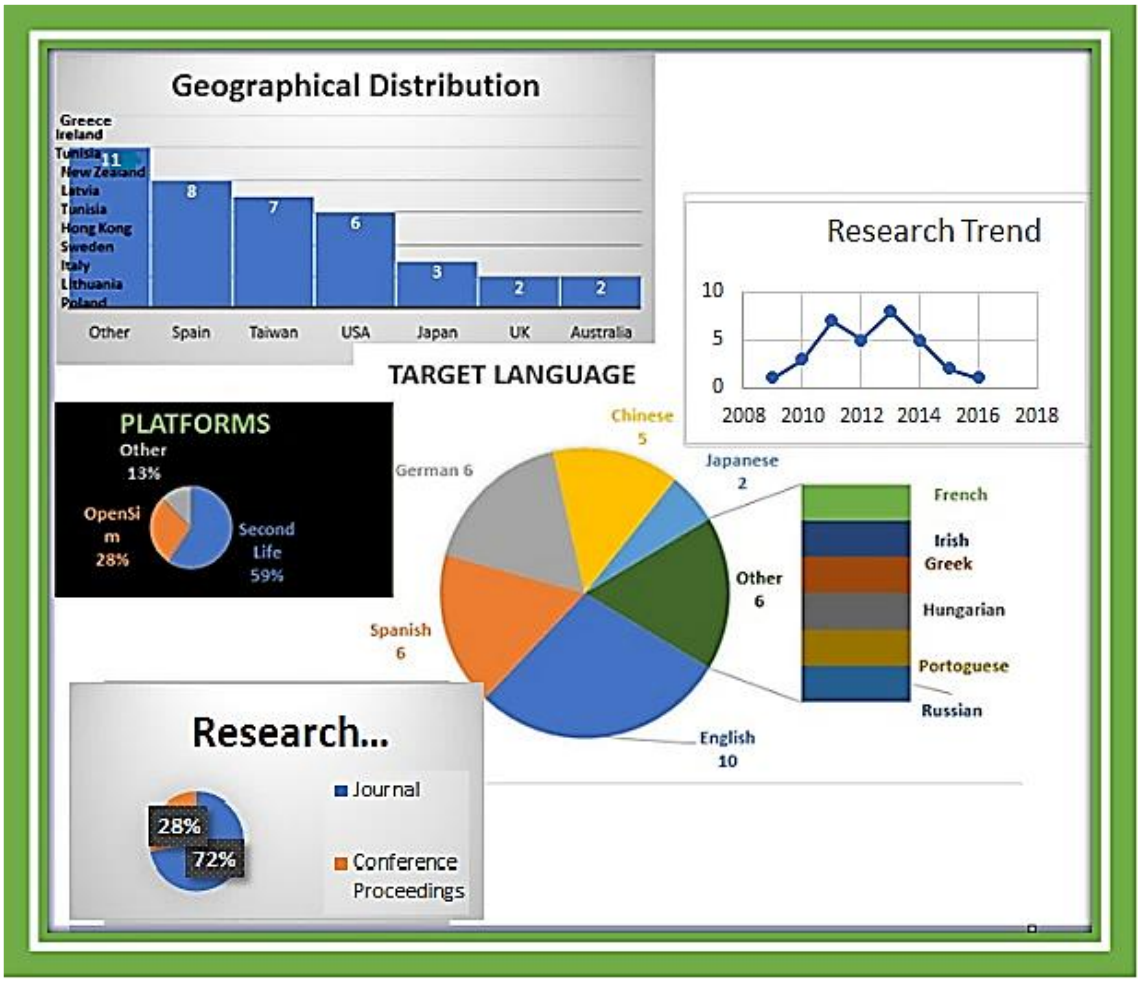
Table 5. Cases included in the literature review

| Identifier | Source | Target Language | Platform | Research's Country | Year | Type of publication |
|---|---|---|---|---|---|---|
| **C1** | (Wehner, et al.) | Spanish | Second Life | USA | 2011 | Journal |
| **C2** | (Lin, et al.) | Chinese | Second Life | Australia Taiwan | 2014 | Journal |
| **C3** | (Grant, et al.) | Chinese | Second Life | Australia | 2014 | Journal |
| **C4** | (Kan, et al.) | Chinese | Second Life | Taiwan | 2010 | Conference Proceedings |
| **C5** | (Berns, et al.,) | German | Open Sim | Spain | 2011 | Conference Proceedings |
| **C6** | (Canto, et al.) | Dutch, Portuguese, Spanish | Second Life | Netherlands | 2013 | Journal |
| **C7** | (Sung, et al.) | Chinese | Second Life | Taiwan | 2015 | Journal |
| **C8** | (Atkins & Gaukrodger) | English | Second Life | New Zealand | 2013 | Conference proceedings |
| **C9** | (Chung) | English | Second Life | Taiwan | 2012 | Journal |
| **C10** | (Braun & Slater) | Mixed | Second Life | UK | 2014 | Journal |
| **C11** | (Knutzen & Kennedy) | - | Second Life | Hong Kong | 2012 | Journal |
| **C12** | (Chiang, et al.) | English | Second Life | Taiwan | 2014 | Journal |
| **C13** | (Liou) | English and other | Second Life | Taiwan | 2012 | Journal |
| **C14** | (Milton, et al.) | English, Greek, Hungarian | Second Life | UK | 2012 | Journal |
| **C15** | (Berns, et al.) | German | Open Sim | Spain | 2013 | Conference Proceedings |

| | | | | | | |
|---|---|---|---|---|---|---|
| **C16** | (Peterson) | English | Wonderland | Japan | 2012 | Journal |
| **C17** | (Oh, Nussli) | English | Second Life | USA | 2014 | Journal |
| **C18** | (Berns, Pardo, Camacho) | German | Open Sim | Spain | 2011 | Conference paper |
| **C19** | (Deutschmann & Panichi) | English | Second Life | Sweden-Italy | 2009 | Journal |
| **C20** | (Lan, et al.) | Chinese | Second Life | Taiwan | 2013 | Journal |
| **C21** | (Berns, et al.) | German | Open Sim | Spain | 2013 | Conference Proceedings |
| **C22** | (Lorenzo, et al.) | Spanish | Open Sim | Spain | 2013 | Journal |
| **C23** | (Peterson) | English | Second Life | Japan | 2010 | Journal |
| **C24** | (Tamai, et al.) | Japanese | Second Life | Japan | 2011 | Conference Paper |
| **C25** | (Neville) | German | - | USA | 2015 | Journal |
| **C26** | (Collentine) | Spanish | Unity game | USA | 2011 | Journal |
| **C27** | (Berns, et al.) | - | Open Sim | Spain | 2013 | Conference Paper |
| **C28** | (Czepielewski, et al.) | English, German, Spanish | Open Sim | Lithuania, Greece, Germany, Poland | 2011 | Conference Paper |
| **C29** | (Dalton, G., & Devitt, A.) | Irish | Open Sim | Ireland | 2016 | Journal |
| **C30** | (Inigo, Rodríguez-Moreno) | French | Open Sim | Spain | 2013 | Journal |
| **C31** | (Ibáñez, et al.) | Spanish | Open Wonderland | Spain, USA, Tunisia, Latvia | 2011 | Journal |
| **C32** | (Blasing) | Russian | Second Life | USA | 2010 | Journal |

The synopsis of the literature regarding second language learning in 3D virtual

environments gives an insight into the profile of the relevant research. The graphs above summarize important information about the target language of the conducted researches, the platform used, the geographical distribution of the research, the trend of the research and the type of the publication.




**Graph 1. Research's Profile**

The most popular language taught is the English language as nearly the 1/3 (ten cases) of the 32 cases use the 3D platform for English language learning. German and Spanish follow with 6 cases per language and Chinese follows with 5 cases. There are also 9 cases with other target languages (such as French, Irish, Dutch, Sweden etc.) that appear a single time. Some of the researches are based on 2 or 3 different languages. The majority of the researches took place in universities of Spain, Taiwan and USA. The most commonly used platform is Second Life despite the fact that it is a commercial product. OpenSim comes second. Only 3 cases (C16, C26, C31) use different platforms such as Active Worlds, openWonderland and Unity and 1 case doesn't refer the platform used.

Most of the papers are published in scientific journals. This fact adds reliability on the results and on the conclusions, we can make. However, a significant percentage of 28 % of the papers is found in the proceedings of conferences.

Regarding the trend of the research, there is an increased interest in the topic from 2008 to 2013. Since then a decline is observed.

### 4.3. Results

#### 4.3.1. Research method applied

**Table 6. Research method applied**

| | | |
|---|---|---|
| Qualitative Research | **C2, C4, C7, C8, C20, C24, C31, C32** | **8** |
| Quantitative Research | C1, C3, C5, C6, C9, C11, C12, C14, C15, C17, C18, C21, C22, C23, C25, C26, C27, C28, C29 | 19 |
| Both | C10, C13, C16, C19, C30 | 5 |

The majority of the researches apply a quantitative method and a few of them apply a quantitative and a qualitative method both.

The 19 cases that do quantitative research collect data through:

- Pre-and post-achievement tests in order to compare the learning outcomes before and after the use of the 3D learning environment and measure the impact of the latter. They also examine the learning results between an experiment and a control group of students that follows a more traditional way of learning (e.g. traditional classroom or virtual 2D environments).

- Motivation tests that investigate if there is a positive impact on the student's motivation to learn the second language taught after the use of the 3D virtual

environment.

- Questionnaires/ Surveys that aim to examine and quantify several parameters such as the students' and teachers' perceptions about second language learning in the 3D virtual environments.

- Chat logs analysis that aims to detect any repeated patterns in the learning process or to measure and evaluate the learning outcomes (e.g. how big is the lexical growth? how much is the interaction among learners increased?)

The 8 cases that do qualitative research are mainly based on at least one of the above types of data:

- teaching journals that include teaching logs and reflections in order to record the teaching and learning process

- audio-visual observational data collected through video recording programs

- Artefacts that include documents, such as lesson plans and email exchanges among the instructors

- Interviews of the students and/ or the instructors in order to provide additional insights into the learning process

### 4.3.2. Participants' profile

In addition, we present in the above table some data regarding the size of the sample of each research, the participants' age and mother tongue.

**Table 7. Basic Elements for the Participants**

| Participants' | Case Identifier | Sum |
|---|---|---|
| **Number:** | | |

| | | |
|---|---|---|
| **< 30** | C4, C7, C8, C16, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C23, C24, C27, C28, C29, C31, C32 | 21 |
| **31-60** | C1, C3, C6, C9, C22, C25, C26 | 7 |
| **61-100** | C5 | 1 |
| **101-150** | C2, C30 | 2 |
| **151-200** | C11 | 1 |
| **Age:** | | |
| **25-60** | C7, C19, C22, C23 | 5 |
| **18-25** | C1, C2, C3, C5, C6, C7, C9 C10, C11, C12, C14, C15, C16, C17, C18, C19, C21, C23, C24, C25, C26, C27, C28, C30, C31, C32 | 26 |
| **12-17** | C13, C20, C28 | 3 |
| **6-11** | C29 | 1 |
| **Mother Tongue** | | |
| **English** | C1, C2, C3, C10, C14, C32 | 6 |
| **Chinese** | C9, C11, C12, C13, C16, C17, C23 | 7 |
| **Spanish** | C5, C15, C18, C21 | 4 |

| | | |
|---|---|---|
| **Japanese** | C16, C24 | 2 |
| **Dutch** | C6 | 1 |
| **Irish** | C29 | 1 |
| **Mixed** | C4, C7, C8, C14, C19, C20, C22, C28, C30 | 9 |
| **Not referred** | C25, C26, C27, C31 | 4 |

The majority of the researches were conducted using a small sample of learners. In 21 of the 32 cases the participants are less than 30. In 7 cases the participants' number ranges from 31 to 60. There are only 4 cases (C5, C2, C30, C11) with more than 60 participants. This fact underlines the lack of large scale research projects.

Case 11 is an exceptional case as it is the only large scale study. During this project 200 students enrolled from Lingnan University in Hong Kong and from Texas A&M University in the US, with about half from each participating university (Knutzen and Kennedy, The Global Classroom Project: Learning a Second Language in a Virtual Environment 2012).

Regarding the age of the participants we can observe a research gap in primary - secondary education and in further education for adults over 25. Only 4 (C13, C20, C28, C29) of the 32 studies are related to school students and other 4 (C7, C19, C22, C23) to students over 25 years old. There are 3 cases (C7, C19, C23) with inhomogeneous sample regarding the age of the participants. These include learners from 25 to 45 years old. For

this reason, we add them to the both corresponding categories. The majority of the papers concern learners between 18 and 25 years old and take place in universities.

In concerns to the native language of the participants, the most common languages are Chinese (C9, C11, C12, C13, C16, C17, C23), English (C1, C2, C3, C10, C14, C32) and Spanish (C5, C15, C18, C21). Some researches (C4, C7, C8, C14, C19, C20, C22, C28, C30) are inhomogeneous. They include and mix people who are native speakers of different languages such as Korean, Vietnamese, English, Spanish, Indonesian, Japanese, Lithuanian etc.

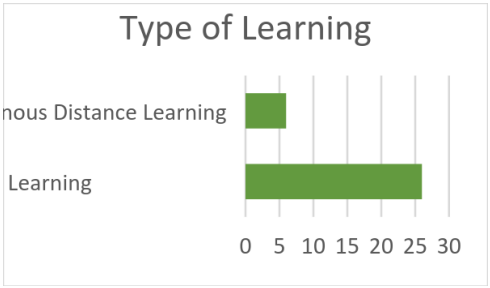
In conclusion, combining the information retrieved from Table 5 and Table 7 we conclude that the most common participant's profile is a learner who is:

- native speaker of Chinese or English (the difference is very small)
- learner of English language
- 18-25 years' old
- a student at a university of Spain or Taiwan

### 4.3.3. Learning type applied

**Table 8. Learning type and research method**

| | Case Identifier | Sum |
|---|---|---|
| Blended learning | C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, C18, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32 | 27 |
| Synchronous distance learning | C7, C15, C17, C19, C20 | 5 |



**Graph 2. Learning Type**

The results in the Table above point out that MUVEs are moving towards complementing the face to face classroom and not replacing it. In 26 of the 32 cases learners attend face to face classrooms and laboratory lessons in the 3D MUVE's. It's also interesting that 6 cases have used them in distance learning. Especially, in distance learning 3D MUVEs might enhance learning as they can offer opportunities for interaction, that would not be given to the students in any other way, given that they study exclusively online.

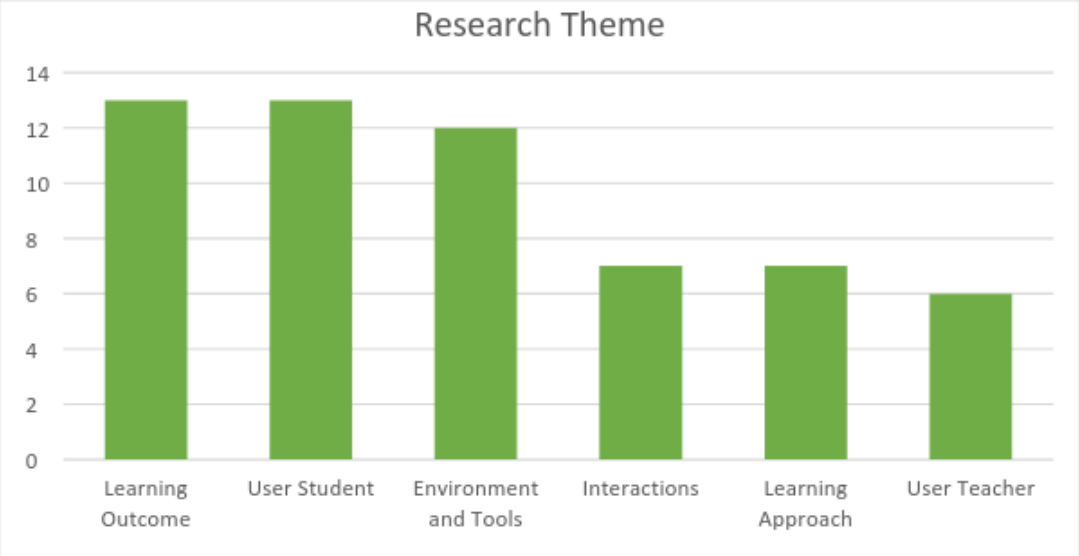
### 4.3.4. Main focus area of the research

**Table 9. Main focus area of the research**

| Focus of the Research | Case | Frequency |
|---|---|---|
| Focus on the learning achievement | | |
| **Speaking, oral production, pronunciation** | **C4, C7, C9, C15, C21** | 5 |
| **Vocabulary** | **C9, C12, C14, C18, C21, C25, C29** | 7 |
| **Grammar** | **C9, C21, C25** | 3 |
| **Reading Comprehension** | **C9, C30** | 2 |
| **Listening** | **C21, C30** | 2 |
| **Writing** | **C21, C25, C30** | 3 |
| **Culture learning** | **C32** | 1 |
| Focus on the User Teacher | **C2, C19, C4, C6, C17, C31** | 6 |
| Focus on the User Student | **C1, C3, C6, C8, C9, C12, C13, C16, C17, C20, C21, C22, C26** | 13 |

| | | |
|---|---|---|
| Focus on the learning interactions among students | **C7, C11, C16, C20, C21, C23, C32** | 7 |
| Focus on the environment: tools and platform | **C4, C5, C8, C10, C11, C13, C18, C21, C22, C24, C28, C29** | 12 |
| Focus on the impact of a learning approach | **C2, C4, C13, C22, C24, C27, C29** | 7 |

Figure 28 gives us a better understanding of the main focus areas of the conducted studies. Most of the researches were focused on the learning outcome after the use of a 3D MUVE and on its impact to the user-Student. In contrast, aspects that have to do with the user-Teacher, the learning interactions and the learning approaches are less explored.




**Graph 3. Research Theme**

**Most of the studies (13 cases) focus on the learning outcome.** The researchers investigate the learning achievements of the students comparing their results prior and after the usage of the 3D virtual environment or comparing the results of the experimental group to the control group. There is a large interest in exploring the potential of the 3D virtual learning environments for fostering language competence such as reading, writing,

speaking, listening skills and for achieving higher grades in several types of tests. The 13 of the 32 cases examine the learning achievements.

A common hypothesis set by the researchers is that 3D virtual environments are suitable for second language learning. Situated learning theory underlines the connection of learning with the participation in a community of practice where students can immerse themselves during oral practices. This community could be virtual as it is suggested in (Sung, et al., 2015; Chiang, et al., 2014; Neville, 2015). Language learning takes place where authentic social interactions in natural conditions take place. In these conditions the learner is not anymore, a receiver of information but acts in real life scenarios and has more opportunities to receive input and produce output (Kan, et al., 2010; Canto, et al., 2013;Chung, 2012;Milton, et al., 2012;Berns, et al., 2011;Blasing, 2010). Additionally, learning can be enhanced through collaborative tasks (Berns, et al., 2013; Garrido-Iñigo & Rodríguez-Moreno, 2013) and games (Dalton & Devitt, 2016; Neville, 2015).

The researchers assume that basic principles of popular learning theories can be supported in these environments and that they can provide or simulate the appropriate circumstances for language learning. Some indicative research questions they test are:

- Is there any increase in output production and in fluency? (C14)
- What do beginner learners learn? (C4)
- How is learners' performance affected in a 3D virtual environment? (C9)
- Is there any cultural awareness? (C32)
- Does the online game enhance students' fluency and accuracy in the target language? (C21)

The most often tested skills are lexical growth (7 cases) and oral competency (6 cases).

Equally examined (in 13 cases as well) is **the impact of the 3D virtual environments on the user- student.** The research questions are related to the perceptions of the students towards learning in a 3D MUVE and to its impact on their psychology. Below are some indicative research questions:

- what are the perceptions of learners towards a multi-user virtual environment? Do

they feel they learn? (C6, C8, C13, C16, C17, C20, C22)

- "Do students' perceptions of (a) the similarity between typed conversation in SL and spoken conversation in the real world, (b) the similarity between communication with pre-programmed NPCs and with a real person, and (c) the authenticity of conversations with NPCs, correlate to their experiences of FLA in the MUVE environment?" (C3)
- How learners gain learner autonomy? (C26)
- How the use of the virtual world affects the motivation? (C1, C9, C12, C21)
- What is the impact on students' self-confidence? (C12)
- How technical and foreign language anxiety is affected? (C3, C17)

Another topic that 12 of the 32 cases investigate is **the suitability of the 3D MUVE and its tools for language learning.** Some indicative research questions are:

- What is the potential of a 3D virtual environment to increase this sense of authenticity? (C10)
- What is the potential of integrating voice chat in the learning process? (C11)
- What is the potential of integrating text chat in the learning process? (C11)
- What are the tools that enhance autonomous learning and motivation? (C18)
- What is the most suitable platform? what are the technological affordances? How should they be adjusted? how to design engaging content? (C4, C5, C8, C13, C18, C21, C22, C24, C28.C29)

Other 7 cases explore **the impact of a specific learning approach** on the students' learning. These studies attempt to point out benefits and challenges of implementing a language learning approach. For example, C2, C13, C29 explore the benefits and challenges of implementing two task-based language teaching approaches in Second Life. C4 examines three different approaches to deliver the lesson: the functional-notional approach, the audiolingual method, and total physical response and compares their effectiveness.

Another research topic concerns the **interactions among learners**. 7 cases focus on this topic. Some of the research questions are:

- What are the communicational strategies? When do they occur? Are they improved? How scenarios affect interactions? (C7, C21)
- What are the conditions which result in the most productive interactions? (C11)
- what kind of interactions emerge? What are their features? (C16, C20, C23, C32)

The least examined topic concerns the instructor's perceptions towards learning in a 3D MUVE and also the instructor's role. Only 6 of the 32 cases focus on the **user-teacher**. Some questions tested are:

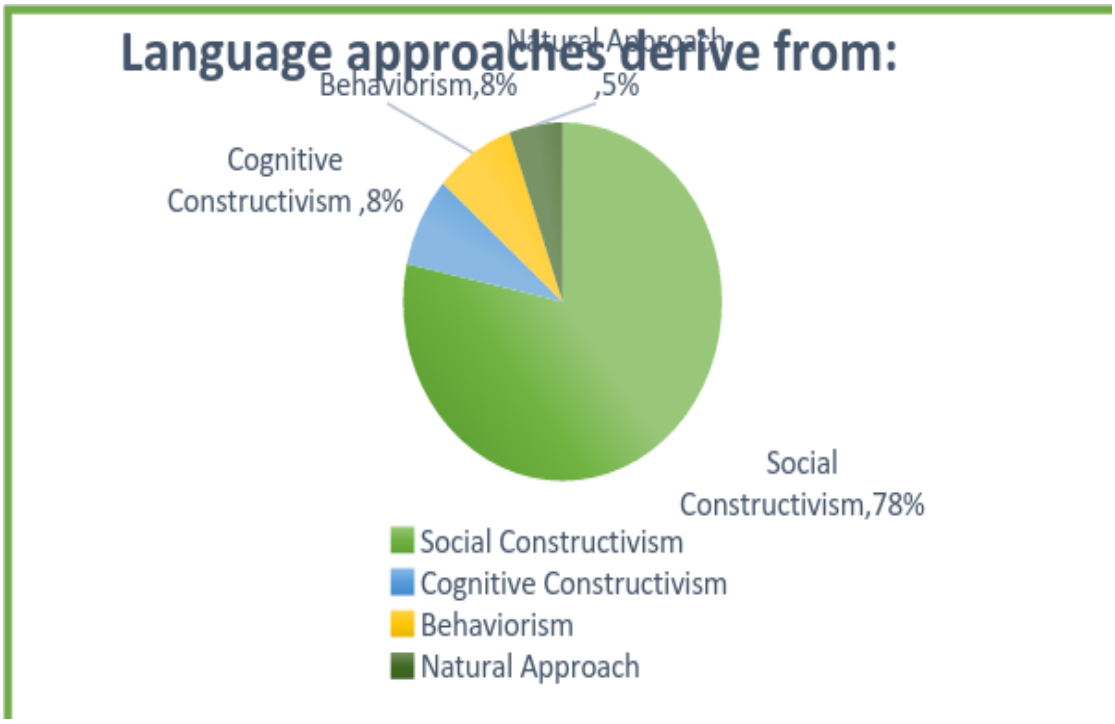
- what is the contribution made by teachers' in the form of virtual role-play and coaching activities? (C19)
- what are the teachers' view about the 3D environment used? Do they feel their students learn? (C4, C6, C17)
- what are the teaching skills required for teaching in 3D Environments? (C17)
- Is it possible to deploy an engaging learning experience to foster communication skills within a 3D multi-user virtual world with minimum teacher's help or on his absence? (C31)

### 4.3.5. Learning approaches applied

**Table 9.Learning Approaches Applied**

| Language Acquisition | Learning Approaches | Cases | Sum |
|---|---|---|---|
| Social Constructivism - Vygotsky | Communicative<br>Task based<br>Game based<br>Problem Solving<br>Co-operative<br>Situated<br>Dialogical<br>Eco-dialogical | C1, C2, C3, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C23, C24, C25, C26, C27, C29, C30, C31, C32 | 29 |

| | | | |
|---|---|---|---|
| Cognitive Constructivism -Piaget | Task based | C5, C10, C26 | 3 |
| Natural Approach- Berlitz<br>Krasen and Terrell | Direct Method<br>Comprehension<br>Total Physical Response (TPR) | C4, C20 | 2 |
| Behaviorism- Pavlov, Skinner | Drill based<br>Audio lingual | C4, C5, C20 | 3 |




**Graph 4. Learning Approach Applied**

The categorization of the papers is based on their author's' description regarding the learning approach they follow. However, many of them did not have any clear statement. The categorization of these articles is based on the principles above.

According to Berns (2011 and 2013) the main-principles of foreign language acquisition can be summarized as follows:

- provide learners with comprehensible language input

- provide learners with meaningful content
- provide learners with clear tasks and goals
- provide learners with regular feedback on their task performance
- enhance interaction and negotiation of meaning
- facilitate and stimulate foreign language output production to enhance fluency and make learners aware of their weaknesses in the target language

Namely, according to Vygotsky's social constructivism learning occurs through social interactions-integrations and through collaborative construction of knowledge (Wehner, et al., 2011; Sung, et al., 2015). The cognitive theorist Piaget believed that learning is an internal process that occurs through interaction with the environment. (Sung, Tang and Chang 2015). The Natural Approach focuses on the vocabulary acquisition, on the understanding of messages in the foreign language and on the principle, that communication is above grammar rules. (Stephen D. & Tracy D., p.57-59, 1983). The behaviourist view of learning emphasises the repetitive conditioning of learner responses Learning is an automatic process of "Stimulus-Response" association that is reinforced through rewards or punishments.Behaviourist Learning Theory is a process of forming habits. (Rosamond, Myles and Marsden 1998)

According to Ibáñez (2011) some of the most common social constructivist strategies are :

- Situated learning: learners learn through social interaction in an authentic situation
- Role playing: learners play roles simulating real life scenarios
- Collaborative learning: learners learn through collaborative, team activities
- Problem-based learning: learners learn in their attempt to solve a problem

The cognitive constructivism is usually related to the task based methods, in which learning occurs individually.The Natural Approach is related to the total physical response approach. the method is one that combines information and skills through the use of the kinesthetic sensory system. The learners used their body to act out the words or phrases or sentences that the teachers said. (Kan, et al., 2010) Behaviourist theory is usually related to the audio lingual/ audio visual method, - associated with the use of repetitive drills. (Rosamond, Myles and Marsden 1998)

Based on these principles we evaluated and categorised the study cases. The categories are cases that apply learning approaches which derive from the Social or Cognitive constructivism or from the Natural Approach or from the Behaviourism.

It was not a surprise that an overwhelming majority (78%) of the studies applied or attempted to apply the principles of social constructivism. The 3D MUVEs are environments that due to their features can easily promote this approach. In the 29 of the 32 cases there is an attempt to promote learning through:

- social integration
- collaboration
- scaffolding
- real life scenarios and usage of authentic materials
- engagement in complex, realistic, problem-centered activities
- game style activities

Cognitive constructivism is applied in only 3 cases (C5, C10, C26) which focus on logical thinking and reasoning, individual construction of knowledge, individual needs and learning pace, autonomous learning through self-directed activities through interactive and authentic material.

There are 2 cases (C4, C20) that emphasize on the comprehension of the input through listening and responding with gesture and sign language, deriving from Natural approach and other 3 (C4, C5, C20) that focus on the pronunciation and memorization through pattern drills and use of multiple media to convey information deriving from Behaviorism.

### 4.3.6. Tools used in the 3D environments

Table 10 lists specific tools and applications that were used in the 32 examined case studies, and the frequency with which each one was met.

**Table 10. Tools used in the 3D MUVE**

| Tools | Case identifiers | Sum |
|---|---|---|
| Voice / Text live chat | C1, C2, C3, C4, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32 | 32 |
| Internal (integrated audio-video players, translation tools, recording tool, visualization tools such as slide show and electronic whiteboard, notecards) | C2, C5, C10, C11, C12, C13, C15, C18, C20, C21, C25, C30 | 12 |
| External (PowerPoint, input software for typing, audio player, Moodle, wikis, YouTube, email, Skype, Google document, tools to record game chat, Web, dictionary, Facebook) | C4, C10, C12, C13, C20, C26 | 6 |

The most frequently used tool is the voice/text chat as expected. This promotes communication. The learners communicate in the public nearby chat or in the private chat messaging. They also communicate through the voice chat.

It is also important to observe that 6 of the 32 cases use external applications such as YouTube, Moodle, wikis, email, Skype, Google documents digital dictionaries, Facebook. As for the Youtube video, it can nowadays be integrated in the most popular platforms, Second Life and OpenSim. It should be noted that the tools provided by MUVEs are limited in number and in nature in order for it to be considered an adequate tool for language learning.

Something more is that educational tools such as electronic whiteboard (C12) or translation tools (C11) or notecards (C2, C13, C20, C30) are not frequently used. This fact in combination with the massive use of the communication tools highlights that these environments are not used as complete educational environment but as an arena for practicing speaking skills.

Finally, it should be noted that the building tool is never used by the students. In this way, an important tool is sidelined from the learning process.

### 4.3.7. Activities in the 3D MUVE

**Table 11. Activities that took place in the 3D MUVEs.**

| Activity | Case identifiers | Sum |
|---|---|---|
| **Communication through Preplanned Tasks** | C2, C4, C5, C6, C9, C10, C13, C14, C15, C18, C20, C21, C22, C23, C25, C27 C28, C29, C30, C31 | **20** |
| **Unplanned Communication** | C1, C7, C8, C11, C12, C16, C17, C19, C24, C32 | **10** |
| **Interaction with highly interactive non-player character (NPC) and objects** | C2, C3, C5, C10, C13, C25, C26 | **7** |
| Posting on forum | C11 | 1 |
| Teleport | C1, C6, C10, C13, C17, C30 | 6 |
| **watching films, videos, animations, presentations** | C4, C11, C12, C19, C20, C23 | 6 |
| **Upload, Browse, Store materials** | **C12** | **1** |

Communication among learners, teachers and native speakers is the most popular activity. The most frequent activity is in line with the most frequent used tool, which is voice/text chat. In 30 out of the 32 cases students interact and communicate in several ways.

In the majority of the study cases (20/32) tasks were designed and pre-planned for the students. These tasks are **role playing games**, in which students work in pairs and communicate playing a specific role related to the setting and the scenery**, language**

**tasks** that practice individually their listening/reading/writing/speaking skills and **game style tasks,** which incorporate competition and/ or team playing. In cases C21, C27, C29, C30 game style activities are designed. Summarizing, on the first stages, the students have to practice individually their skills through quizzes and on the final stage they are separated in groups and they compete or they work in pairs in order to complete a task.

In 10 of the 32 cases students are let free to **communicate in an informal way** with other students or with native speakers. The oral production in this cases is not strictly guided by rules or expected outcome. For example, in C17 students meet online with pre-service teacher students and chat stimulated by the setting and a given topic.

**Interaction with non-player character (NPC) and objects** is another activity that takes place in 7 of the 32 cases. This is considered to be a pre-scheduled activity, usually individual and accompanied by multiple choice quizzes.

**Teleporting** occurs in 6 of the 32 cases. Through virtual tours students explore realistic simulations of historical and modern places or fantastic locations. They describe their experiences and immerse in these environments.

**Watching films, videos and presentations** is another activity met in 6 cases. Students might watch an educational video or each other's presentation on a given topic.

### 4.3.7. The instructor's role

**Table 12. The instructor's role.**

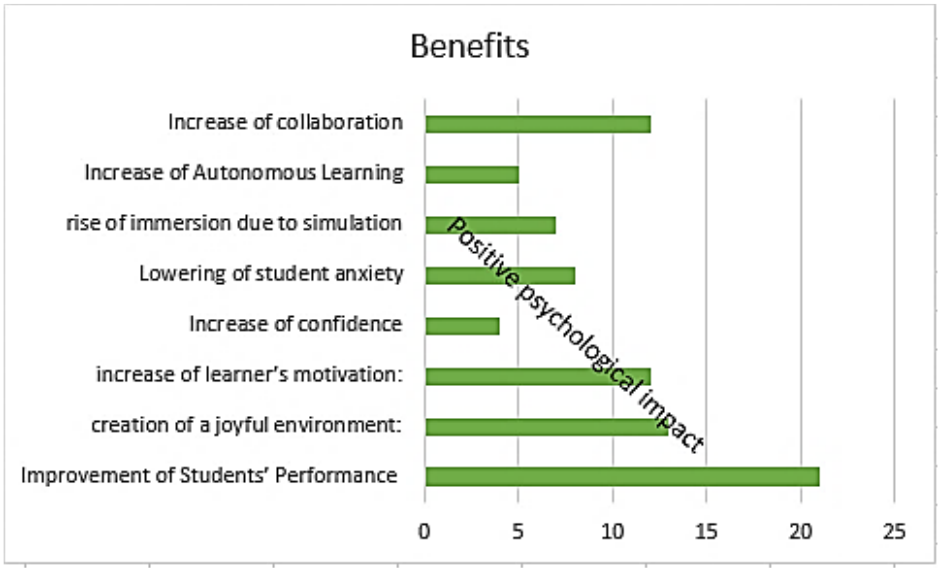
| Role | Case Identifiers | Sum |
|---|---|---|
| **Facilitator** | C1, C2, C4, C5, C6, C8, C11, C12, C13, C15, C17, C18, C20, C25, C26, C27, C28, C31, C32 | 18 |
| **Trainee** | C2 | **1** |
| **Creator of teaching material** | C2, C4, C8 | 2 |
| **Developer of basic 3D constructions** | C8 | 1 |
| **Absence of instructor in the 3D environment** | C6, C7, C10 | 3 |

In most of the cases the teacher acts as a moderator. The teacher offers help , organizes the tasks and facilitate the learning process without to play a leading role. In some cases, (C2, C4, C8) the teachers created the teaching material but only in one case (C8) they participated in building. This might imply a lack of skills needed to develop teaching material in a 3D MUVE and an emerging need for training. However, only in one case the teacher participated as a trainee. Finally, there are 3 cases (C6, C7, C10) who attempt to test these learning environments in the absence of the teacher. In cases like these the researcher examines the chat logs later and the teacher meets the student another time only in the classroom or never. There are also 7 cases that are not included in the table above, as they provide no information about the role of the teacher.

### 4.3.8. Benefits identified in the study cases

**Table 13. Benefits.**

| Benefits | Case identifiers | Sum |
|---|---|---|
| **Improvement of Students' Performance** | C4, C5, C6, C7, C9, C10, C12, C13, C14, C15, C16, C18, C21, C20, C23, C24, C25, C27, C28 C31, C32 | 21 |
| **Positive Psychological Impact** | | |
| a. Lowering of student anxiety: | C1, C3, C13, C16, C17, C18, C23, C30 | 8 |
| b. increase of learner's motivation: | C1, C3, C5, C6, C9, C12, C13, C20, C21, C22, C23, C25 | 12 |
| c. increase of confidence and self-efficacy: | C12, C15, C30, C32 | 4 |
| d. creation of a joyful and entertaining environment: | C5, C11, C13, C16, C18, C21, C22, C23, C28, C29, C30, C31, C32 | 13 |
| e. rise of immersion due to simulation | C8, C9, C13, C25 C28, C31, C32 | 7 |
| **Increase of Collaboration** | C2, C7, C9, C10, C13, C15, C16, C19, C20, C21, C22, C23 | 12 |
| **Increase of Autonomous Learning** | C8, C9, C18, C19, C23 | 5 |




**Graph 5. Benefits identified**

The majority of the cases identified as a common benefit of the 3DMUVE's the improvement of the students' performance. Among the 32 cases the 21 found positive results in writing, reading, listening, speaking skills, in the vocabulary growth and in the rise of grammar and cultural awareness. The multimodality of the 3D MUVE gives opportunities for a variety of interactions. The learners can communicate with the other learners through voice/text chat. They can also interact with the environment either by exploring new places or by communicating with robots or by interacting with objects. More specifically, as the study cases indicate, pre-scheduled activities can enhance learning experience and outcomes.

There are also very encouraging results regarding the impact of the 3D MUVE on the students' psychology. Previous research has shown that foreign language anxiety (FLA) can have negative effects on learner performance and learning outcomes (Grant, Huang and Pasfield-Neofitou 2014). Findings show (C1, C3, C13, C16, C17, C18, C23, C30) that learning in a 3DMUVE lowers students' anxiety. Students feel more relaxed and more confident to practice their speaking skills with robots or other avatars instead of real people in a face to face classroom. In a 3D MUVE the attention is moved from the student to the avatar and the students distinguish themselves from their avatar. There also multiple channels for participating, through voice/text chat. In addition, the anonymity

due to the lack of camera, creates a stress-free environment. As a result, students feel more confident to take risks and to participate more actively. Consequently, the learning achievement is increased.

Motivation is another important factor in the learning process that can affect language learning (Chiang, et al. 2014). The results of 12 cases (C1, C3, C5, C6, C9, C12, C13, C20, C21, C22, C23, C25) show that students feel more motivated to learn the target language after using the 3D MUVE. The similarity of the environment to real life settings enhance the sense of immersivity, the sense of being there and consequently the motivation is increased. Moreover, role playing or communicating with native speakers encourages student motivation as they believe that this practice will be useful for future real-life communicative situations and will help them improve their speaking and listening skills. Motivation is also increased through game style activities. Tasks that adopt game features have a very positive impact on students' willingness to learn the target language.

Another benefit indicated in the research papers is that the learning process in a 3D MUVE is more entertaining. Fun can keep learner motivated and boost learning (Prensky, Digital Game-Based Learning 2001). Finally, collaboration is increased through in-world social interactions and team working activities (C2, C7, C9, C10, C13, C15, C16, C19, C20, C21, C22, C23) and autonomous learning is promoted (C8, C9, C18, C19, C23) since the teacher acts as a facilitator.

### 4.3.9. Problems identified in the use cases

**Table 14. Problems**

| Problems | Case identifiers | Sum |
|---|---|---|
| **Technical issues** | C2, C4, C10, C11, C14, C16, C17, C20, C24, C28, C31 | 11 |
| **Insufficient learning results** | C2, C4, C14, C20, C25, C28 | 6 |
| **Safety issues** | C4, C20, C32 | 3 |
| **Negative Psychological impact** | C3, C32 | 2 |

| | | |
|---|---|---|
| **Organizational issues** | C4, C11, C13 | 3 |
| **Building is time or money consuming** | C8, C14, C17 | 3 |


**Graph 6. Problems Identified**

Technical issues are the most commonly identified problems. Technical issues with the hardware or the software are often related to audio problems or to the inappropriateness of the software for all computers or to the unnatural reproduction of the physical space and of the interlocutors in the dialogue. In addition, students might face technical difficulties due to the lack of gaming or computer experience (C10, C11, C28, C31). A common problem they face is the camera control.

Another identified problem is that the learning results are not satisfactory (C2, C4, C14, C20, C25, C28). For example, the vocabulary gained is considered to be poor, the environment is distractive, the students overlook important information and the environment is insufficient for beginners. A commonly observed problem is the lack of body language and eye contact that has a negative impact especially in pronunciation. Watching the teacher's face and mouth movement is an essential process while learning a language, especially at the beginners' level. But it is almost impossible in this teaching environment. (Kan, Y. H. a, Lan, Y. J. a*, Indy Y.T. Hsiaob, Stephen J.H. Yangb 2010).

When students are located in a public space there is always the risk of facing some dangers, especially if they are not adults. Safety issues have been recorded in uncontrolled public spaces where native speakers may tease the students or express hostility. For example, in C32 some of the native speakers began to tease the learners about their poor language skills using vulgar language.

Another problem that has been detected has to do with the students' psychology (C3, C32). The more the students feel that a 3DMUVE environment is realistic and similar to conversations with real interlocutors, the more foreign language anxiety (FLA) they experience. This is paradox given that students experience less foreign language anxiety in the 3DMUVE (Grant, Huang and Pasfield-Neofitou 2014).

Moreover, there are organizational issues especially in the synchronous distance learning cases. Pupils might not show up or they find it difficult to collaborate and be on time with pupils from another country due to the time zone difference. The difficulty in class control is underlined through an example in C4. When a guy appeared in the system, after talking to the learner, the stranger and the student left the system together. (Grant, Huang and Pasfield-Neofitou 2014). Cases like this show the need for creating private learning environments. However, it is time and money consuming to create a secure private environment and pre-schedule tasks (Atkins & Gaukrodger, 2013;Milton, et al., 2012;Oh & Nussli, 2014).

### 4.4. Conclusions

This section attempted to map the research field of second language learning in a 3D MUVE. To this end, 32 cases studies that used 3D MUVE environments for blended or distance synchronous learning were studied. An observation regarding the cases we have studied is that the research on this field is mainly shared by two countries (Spain, Taiwan), it's mainly orientated to teaching four languages (English, Spanish, German, Chinese) and is mainly conducted with small samples of participants (under 30) between 18 and 25 years old. These observations point out that the field is still emerging and still under exploration.

The general consensus from the cases' investigation is that 3D MUVEs provide a suitable environment for language learning and practicing speaking, listening, writing, reading skills in a constructivist framework. The features of the virtual worlds allow the construction of the knowledge through collaboration and problem solving and offer possibilities of interaction with the environment, the objects and other community members through avatars. (Ibáñez, et al. 2011).However, these environments are not tested by the studies as exclusive tools for language learning but as complementary educational tools that can be used in parallel with face to face learning.

The majority of cases indicate that 3D MUVEs include a variety of tools and activities that support communication and interaction among learners and between learner and environment. The most common tool used is the voice/ text chat. This is in accordance to the literature that states that these environments can reinforce communication skills through meaningful interactions (Peterson 2010) Such interactions were realised through a variety of activities. Popular activities were game style tasks, role playing, drills, quizzes, virtual tours, speaking and exchanging opinions on a given topic. There were also many cases that didn't include any pre scheduled task but used the environment for natural, unplanned communication.

Despite the fact that there are many impressive 3D virtual language learning environments there is a lack of 3D designed educational games in them. Most of the researches test repetitively the potential of the environment based only on communication activities (e.g. role play) and not collaborative. The few game style activities detected do not promote the collaboration in a team but in pairs. Also, they are often designed spontaneously or they do not make use of the full potential of the 3D environment. Activities that do not use the virtual space or the multi user and collaborative capabilities of the platform were often detected. Furthermore, it seems that there is a bigger emphasis on the modelling of the objects and of the environment instead of the lesson modelling.

Another factor intended to be examined was the instructor's role. As it was observed, instructors took on the role of a facilitator rather than a tutor. The instructor was usually present as an avatar and acted as a co-ordinator offering help, answering questions and

trying to solve technical issues. However, only in on case the instructor participated in the creation of the 3D educational material (Atkins and Gaukrodger 2013). This fact in combination with the small number of case studies that focus on the user-teacher, points out the necessity for further exploration on the instructor's role.

The corresponding section within this article listed a variety of benefits that focus on the educational value that 3D MUVEs add to the learning process. In the majority of the study cases the students' performance was improved after the usage of the 3D environment. In addition, the impact on their psychology proved to be very positive: on the one hand, the foreign language anxiety was reduced and on the other hand the motivation, the confidence and the sense of presence were increased. It was also observed that that participation through collaboration was increased and autonomous learning was enhanced. Finally, the learners stated that they enjoyed the experience.

Lastly, a number of problems were observed during 3D MUVE's usage in the examined cases. The most important issues were related to technical problems with the hardware or the software. The most frequent problem had to do with the audio and the camera control. The lack of gaming experience played a negative role. Another problem identified is the insufficient learning results, more specifically in beginners' classes where pronunciation is still on progress. The lack of body language and of the potential to watch teacher's mouth movements stand as a barrier to the improvement of pronunciation (Kan, Y. H. a, Lan, Y. J. a*, Indy Y.T. Hsiaob, Stephen J.H. Yangb 2010). Another issue is privacy and safety in public spaces (Blasing 2010). This is an important aspect, bearing in mind that creating private, secure environments is time and money consuming (Milton, Jonsen, et al., Foreign language vocabulary development through activities in an online 3D environment 2012) and same is training students for these environments (Oh and Nussli 2014).

In summary, our work supports other studies suggesting further research on the topic is needed, since the incorporation of 3D MUVEs in second language learning is still at an early stage and no concrete success results have emerged that lead to the development of best practices. Furthermore, research is required for the appropriate design of courses that

will use 3D MUVEs as a tool for language learning. This will facilitate the adaptation of the course in case the aforementioned problems occur and the exploitation of the corresponding benefits according to the course's specific objectives.

# 5. Game Design

## 5.1. Introduction

An effective educational game should combine education with entertainment. In order to meet the learners' and teachers' expectations it should be designed in a way that motivates, engages and offers an entertaining learning experience. Previous studies indicate that educational games should include game design and good pedagogy in order to ensure learning effectiveness (Ibrahim & Jaafar, 2009). In other words, game designers and educators should collaborate and contribute equally to the final result. On the one hand, a game that doesn't apply any pedagogical approach would not be so effective as an educational tool. On the other hand, a game that only educates, would not be a game at all.

This unit describes the preliminary work before the design of our game. Section 5.2. states what is the educational game design approach selected. In section 5.3. the criteria for the 3D platform are set. In section 5.4. the platform of choice is described analytically. Section 5.5. presents the selected educational game design model, upon which we build and develop a new one, enriched model. Finally, section 5.6. refers to the proposed game design model.

## 5.2. The selected educational game design approach

The educational game design approach we selected is the approach described in section 2.2.3. This approach dictates designing from the beginning an educational game that is tightly linked to a specific curriculum or learning content.

We are going to design a game from the beginning in order to serve the learning goals of

a specific subject, Latin language. The game will be linked to a very specific learning content: the vocabulary related to common objects and furniture in a house. However, it can be modified to adapt in other languages or other topics. The learners can play the game in order to practice their knowledge on that section.

As long as reducing cost, time and technological requirements is a desired objective, in this project we are going to use a multi-user, 3D virtual platform that allows the creation and customization of a virtual environment and has many built in features that not only facilitate the building process but also add educational value to the platform and make it suitable for game design and game based learning.

### 5. 3. Platform selection criteria

The selection criteria for the virtual world platform were set in accordance with the development requirements of the game, the game scenario and the budget. They are presented in the following list:

**General criteria:**

- Platform popularity for educational projects as well as a large, active and supportive community of developers combined with open, public grids.
- free and open-source or very low cost
- Free downloadable, multi-platform client software
- System Stability
- Straightforward server configuration and parameterization in order to fully control the VW and the usage rights at will.
- Independency through self-hosting possibility and multiple vendor support. It is important to have the option to download the whole virtual environment and transfer it to another hosting company
- Real-time communication through text chat, IM and Voice
- Embed LMS/VLE functionality inside the virtual world.

**Specific criteria:**

- In-world content creation: Built-in 3D editor for in-world creation, editing and scripting of 3D virtual objects and landscapes.

- Fully customizable avatars: Not all the platforms give the same options for customizing the Avatars. There are platforms that ask the users to choose from a limited collection of Avatars with no possibility of customization. In contrast, there are platforms that allow users to upload their own styles, such as hair, skin, shape in their inventory and create an avatar that just looks like the physical person. The more the users can tailor their avatars they more they identify with that and the more immersed they feel in their environment. Additionally, when all the users look like their avatars the feeling of presence is increased.

- Possibility of free backup of objects and virtual environments. The platform should give backup options. The owner of a private grid should be able to backup any objects, entire inventories, regions or the whole grid.

- Hyper grid connectivity: Hyper grid connectivity gives the Avatars the freedom to visit other grids in the metaverse without creating new Avatars. So, they can participate in events that happen in other worlds, visit stores and buy products, share transferable inventory items, meet new people, message their friends across grids and transfer currency. Besides these, users can also take objects from one grid and bring them to their own grids. Not all grids are open. Visiting closed grids requires the creation of a new avatar.

- Control and protection of the Content: The platform should give the users the right to fully control their content and determine the use policies in their grid. That means that they might give the license to other users to use or copy or save their model.

- Rich downloadable content: Most virtual environment platforms allow the import of ready-made content. There are websites that work as repositories of basic models. The models can be either given for free (these models are called freebies)

or at a low cost. The existence and availability of free, rich, open, and customizable pre-made content (i.e. 3D objects, scripts, functionality modules) is also desired. Uploading a pre-made object in your world can reduce the time needed for building. However, this is only the beginning. The objects have to be optimized, textured and scripted and that might involve a lot of manual work. That's why a rich content marketplace that makes it easy to buy or download for free content is considered to be very useful.

### 5.4. Description of the selected Platform

After comparing the aforementioned platforms in section 2.3, we selected OpenSim. The popularity of a platform is very important for somebody who has no experience with the 3D virtual world platforms. Finding online resources, useful information, tutorials, people who can help and answer questions is a critical factor. Adding to this OS's compatibility to SL, the most popular 3D virtual world platform for educators in all over the world, as well as its open and modular design, makes OS platform ideal for educational institutions and enterprises that need to have full control and maximum flexibility on their 3D simulations, in virtual worlds that offer pretty much the same graphics, functionality and building possibilities as Second Life but in significantly lower cost (or at no cost at all).

- Second Life has the largest community among 3D virtual world platforms. Due to their close relation, most Second Life documentation can be used for resolving Open Simulator issues as well. For users of SL, no retraining is required. For new users, there is a wealth of material -- wikis, how-tos, videos, blogs, in-world tutorials, support groups and OpenSim has more than 180 active public grids c -- available to teach newbies how to use Second Life, how to build, and how to script. Almost everything is directly applicable to OpenSim.

- Based on the criteria set the platform should be open source and free. Among the open source platforms OS is more mature. OW evolve in slower rate comparing to OS and it is supported by smaller community of developers. As for the hosting options, there is a large variety of vendors, there are more than 50.

- Regarding the content, the OS gives more control to the user than the other platforms. Owners of private grids can back up any objects, can make backups of entire inventories of individual users, of entire regions, or of the whole grid. The users also can save objects to their inventory without owning any land.

- Another exceptional feature is the build in world editor. OS currently supports almost all LSL commands, and adds a number of unique OSSL commands. Users can also write their own scripting commands and include them as an OS module. The Avatars are fully customizable in such an extent that can users can create avatars alike to their physical appearance

- Additionally, OpenSim has the hyper grid. Currently around 100 grids are hyper grid enabled, allowing users to teleport back and forth without creating new avatars. Users can save hyper grid landmarks, make hyper grid friends, even buy objects on one grid and take them home over the hyper grid to their own grids. Currently, grid owners can turn hyper grid on or off at will, and also choose whether to allow their content to travel or not.

- There is also a hyper grid-enabled virtual currency, which is currently used on over 30 grids. Moreover, the OS currency can be traded for US dollars, Euros, and Linden dollars on the Virwox exchange. It is accepted on 28 different grids, and if a particular grid goes out of business, the currency will still retain its value[14].

- One more strength of OS is the LMS/VLE functionality, that can facilitate the accomplishment of the project's future objectives and can be integrated only to the OS platform through the open-source SLOODLE module of MOODLE. The other platforms apart from Second Life do not have that potential.

- Comparing to SL the most important drawback of Second Life is the lack of independency regarding the hosting options. All Second Life land is provided by a single vendor, Linden Lab and all the vendors of land are resellers. Another

[14] http://www.hypergridbusiness.com/2011/05/second-life-vs-opensim/

drawback is the lack of control towards the content (users cannot back up content that have not created from scratch and Linden Landen can remove content from the inventory or the region), the lack of hyper grid connectivity and the charge for owning a land.

- As for the Active Worlds platform, the basic drawback is the need to pay in order to own a land, the graphs that are basic comparing to OS and their low popularity. Additionally, the lack of total control of the created objects is another disadvantage. There is no inventory where the user can save anything they take from other users or anything they create. Unless the users do not own a private land, they have to leave their object in a public space. Nobody can delete it but they cannot hide it or import it to another platform. In contrast, Second Life users can transfer their content to OS.

- Basic drawbacks of OW comparing to OS are that the first one has a smaller community, has no build-in world tool for avatar customization and 3D object creation/editing as well as the fact that they do not offer a built-in mechanism for NPC creation and programming. Finally, there are no public OW grids, something that make things difficult for an inexperienced user.

**Table 15.** OpenSim Basic key features

| **Client/viewer** | **Client (or 'viewer') : open-source, multi platform, free downloadable** |
|---|---|
| **Server** | open-source, multi platform, free downloadable |
| **Hosting** | Self-hosted virtual world on own server(s): Free<br>Hosting on a variety of vendor server(s); Prices range from 15USD/month to 100USD/month |
| **Community** | Large, easily accessible Community |
| **Communication** | Build in Voice and Text /IM chat |
| **Building** | Build in building editor<br>In-world scripting: Linden Scripting Language (LSL), OpenSim Scripting Language (OSSL), C# |

| | |
|---|---|
| **Hypergrid connectivity** | Avatars can teleport from one grid to another |
| **Avatars** | Fully customizable |
| **Back up** | Region and avatar inventory backup, upload, transferability |
| **Content** | Content protection is completely up to the grid owner, Plenty of free, downloadable content (freebies) |

### 5.4.1. OpenSimulator architecture

This chapter describes in detail the architecture and the technical features of the OpenSimulator platform. OpenSim is released under a BSD License. The release used in this project is the 0.8.2.1. version. OS is written in C# and is designed to be easily expanded through the use of plugin modules. At the broadest architectural level the main components of OS system are three: a) the server (or "simulator"), b) the client (or "viewer") and c) the services (Maratou and Xenos 2014) Following these components as well as the features of Opensimulator are presented.

### 5.4. 1.1. Server

The OS server handles all the alterations made in the virtual environment, all the scripting executions and additionally responds to the client's requests. The server reacts to all the changes made either from the user actions or from executing a scripting on an object and updates the virtual world status. That's why it is called simulator. In a few words, it supports the simulation of one or more fixed virtual world areas the so called "Regions". The processing power of the server machine and the network bandwidth are the only limitations posed on the maximum number of the Regions.

There is also a variety of server commands that can cause different results. For example, through server commands a whole region can be loaded to the server or the terrain of the environment can change texture or an object can change behavior.

### 5.4.1.2. Client

In order to connect in a 3D virtual environment that is available by the server, a client or

viewer is needed. The client is responsible for the graphical rendering of the virtual world. The client is connected to the server of the virtual world and retrieves information not only for one Region but also for events occurring in neighboring Regions. Consequently, the client is not limited by the resources of a single simulator. The viewer provides the users interface with a variety of tools such as : client setup, landscape modification, avatar in-world customization, communication and movement, in-world 3D building, editing and scripting, file upload, social networking, etc. OS does not come with its own viewer meaning that the user has to download and install locally a compatible viewer of a third-party software organization. There are many available with different features that can influence the quality of the graphics.

**Table 16. Compatible viewers [15]**

[15] http://opensimulator.org/wiki/Connecting

| Viewer Name | Based on | Grid Selector | Grid Manager | Graphical | Mesh | OSSL support | LightShare [1] | Multiple Attachments | Multiple Clothing Layers | MOAP support | Varregion support | Operating System |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Singularity | Snowglobe | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | |
| Alchemy | Snowstorm | √ | √ | √ | √ | x | x | √ | √ | √ | √ | |
| Cool VL Viewer | Snowglobe | √ | √ | √ | √ | √ | X | √ | √ | √ | √ | |
| Kokua | Snowstorm | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | |
| Firestorm viewer | Snowstorm | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | |
| Radegast Metaverse Client | libomv | √ | X | Text client with graphical component | √ | X | X | √ | ? | X | √ | |

Based on these properties and on the characteristics of the equipment that would be available for us, we decided to use Firestorm, because of its performance, versatility and innovative nature.

#### 5.4.1.3. Database

The backend of the system consists of the Services which provide the virtual world simulator(s) with the common resources requested. All the resources data elements are permanently stored in one or more databases under a unique ID which is called Universally Unique Identifier (UUID). In the classic architecture access to these services always takes place via the simulator through well-known Uniform Resource Locators (URLs) (Maratou and Xenos 2014).

There are many Services offered by OS, but the most crucial for the client-server communication are the following:

- User Service: This persistently stores user data, such as names, passwords and biographies and offers authenticity mechanisms during the initial user login to the virtual world.
- Grid service: The grid service keeps information regarding the coordinates and the

positioning of every region in the virtual world. Simulators of other regions request this information in order to find out about their neighboring regions.

- Asset service: This service stores all media data persistently. Discrete items of media data are called "assets" in OS terminology. Types of asset include textures, scripts, sounds, object representations etc.

- Inventory service: Each avatar owns an inventory in the virtual world which is similar to a personal warehouse with items (objects, scripts, textures, etc.) from the virtual world. Every item in this inventory holds references to a specific asset. The inventory service persistently stores this information.

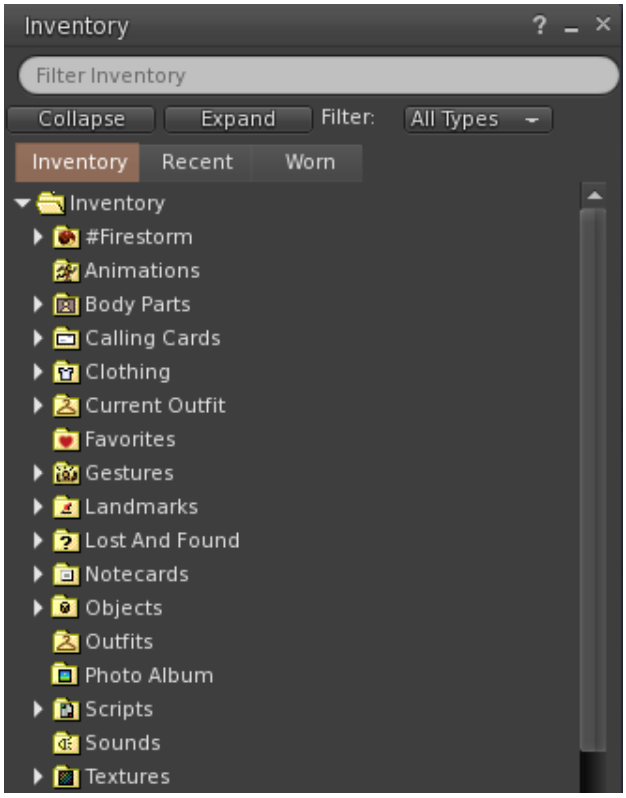



**Figure 27: Screenshot of the user's inventory**

#### 5.4.1.4. Server, Client and Database Interaction

An example of the interaction between client, regions simulator and services in classic standalone architecture is shown in Figure 28. As presented in the figure, only the simulators have access to the VW services – clients, except for login phase, always send and receive data through a simulator instance.

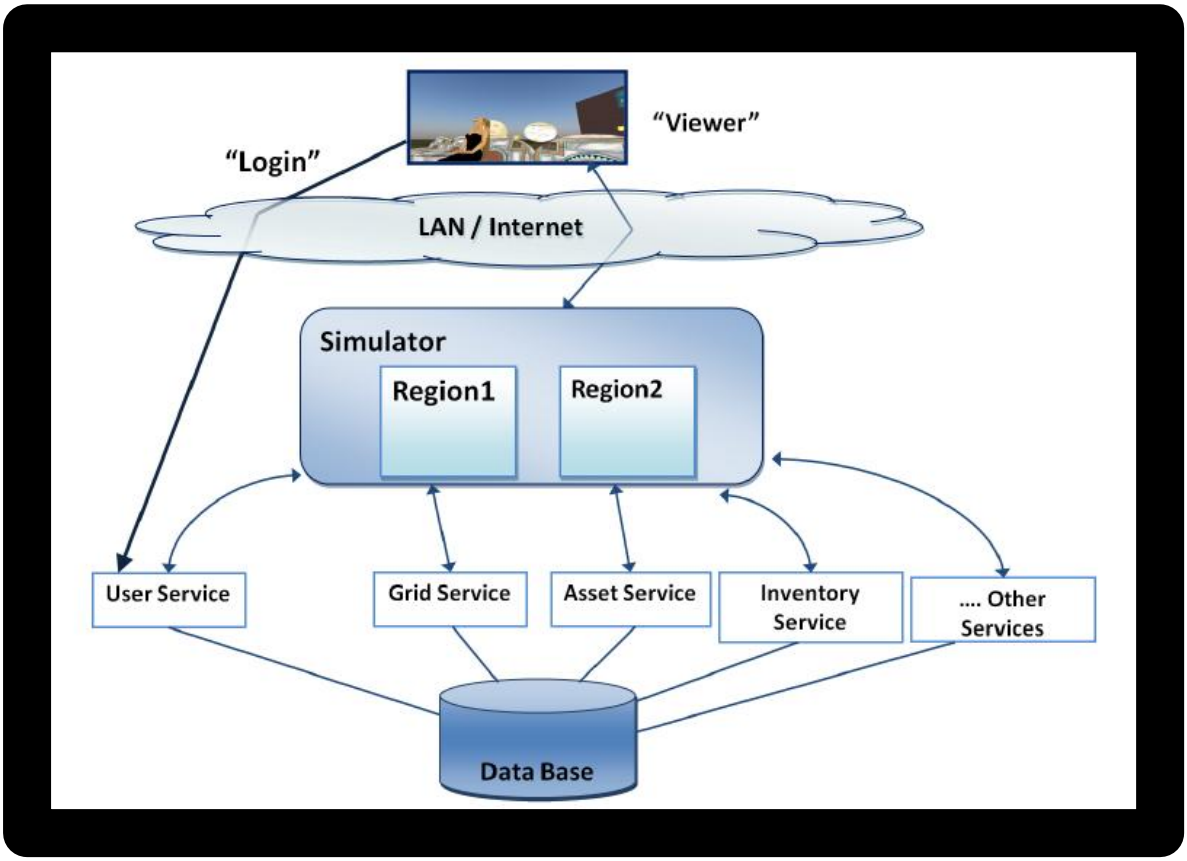



**Figure 28:** Interaction between client, regions simulator and Database **(Maratou and Xenos 2014)**

### 5.4.2 Technical Features

The presentation and the description of the technical features of the OpenSim platform are based on the information retrieved from the official website[16] of the platform and on the personal experience gained through the game creation.

#### 5.4.2.1 Built in Editor

The built-in editor allows in-world model creation. Users can create basic 3D models from scratch, or to view and modify more-complex 3D models that were created by other users. Building starts with basic shapes, the so called "prims". The combination of these can result to more complex objects. Numerous advanced features are provided such as skew, rotation, cuts, shadows, lights and photorealistic aids. In addition, web pages, audio, video, scripting can be added on a virtual object.

[16] http://opensimulator.org/

The objects can be saved, moved and taken away in the personal warehouse of the user. The user can determine the content policy he prefers. Copying an object can be allowed or not depending on the rights the owner wants to give.

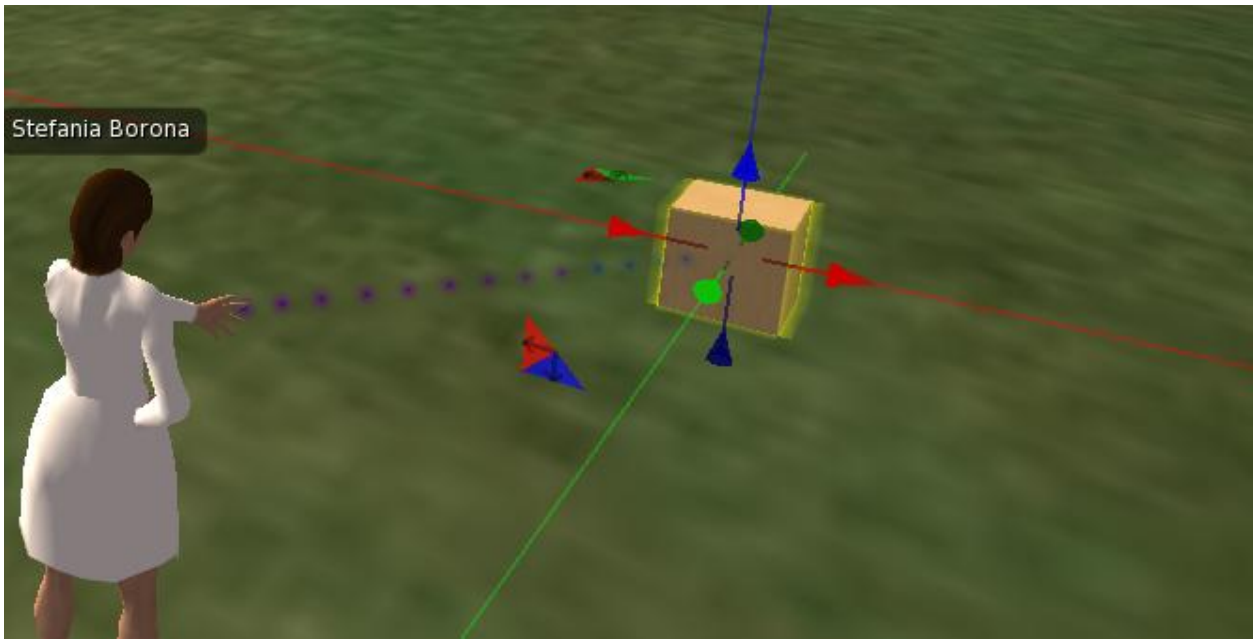



**Figure 29: XY axes and rotating facilitate building**

#### 5.4.2.2. Avatars

The Avatar is the virtual representation of the user in the virtual world. The user can choose the sex of the avatar and can change clothing and outfit as many times as desired. New clothing can be created or can be found on the virtual market places. The avatars are highly customizable. The user's interface offers detailed customization of the avatar: the size and the shape of every part of the body and the head can adapt to the user's preferences. The features are so detailed that users can personalize their avatars as to look like them. An Avatar can walk, run, fly, sit and do some gestures.


**Figure 30: screenshot of the tools for Avatar configuration**

#### 5.4.2.3. Communication

The OpenSim environment offers a public chat box where one or more users can chat. This is visible to any avatar in a given distance. There is also a private chat box for private conversations. Avatars can continue talking to each other even if they are in the same grid as IM communication does not depend on the distance between the Avatars. Instant messages may optionally be sent to a user's email when the user is logged off, although message length is limited. If a message is sent to an offline user, it will also be saved to be viewed when the user logs on again. There is also an in-world voice chat possibility.

Moreover, there are social networking functionalities. Users can make friends and create or participate in groups with common interests.

#### 5.4.2.4. Interaction

There are two basic types of interaction: The interaction among the avatars and the

interaction between the avatars and the environment. The user can interact with the other users through the aforementioned communication channels. The interaction with the environment occurs through touching objects. The systems can display several messages such as or pop up questions / quizzes.

#### 5.4.2.5. Tracking learners' behavior

The database system stores information with regard to student behavior and interaction within the environment i.e. interaction logs from avatars, tracking movements, documents and objects developed by users, etc. These logs can be used by both teachers and researchers to perform data analysis of student behavior.

For the design of "Escape Domitian" we can have two types of data regarding students' behavior:

- Real time data, where data is obtained while students and teachers are within the virtual environment. Tracking players' activity while they are playing means that the instructor is able to watch how much time do they spend to each part of the activity, what objects do they click, how many mistakes they make, if they participate, if they talk etc. so as to take immediately appropriate action in accordance with their need. This is possible through the heads-up display (HUD). A heads-up display (HUD) is a two-dimensional user interface element that controls inworld elements, such as your avatar or animations. A HUD typically consists of a control panel with buttons that do certain things; you activate it by "wearing" it as you would an article of clothing. HUD acts as an object or objects you link together and each of them has script or scripts inside. When the teacher wears the HUD he/she can "hear" everything said in any of 4 rooms through the nearby chat, he/she can click on all the objects even if they are further than 10metres, he/she can track the doors' activity etc.

- Data can also be analyzed once students have quit the game. All the conversations are saved in a log file. So, the instructor can identify patterns that repeat in the student's behavior and focus on their needs. In addition, this data provides information that can help us improve the game. These are logs concerning student behavior.

#### 5.4.2.6. Scripting

An important feature of OS is the scripting. OS supports Linden Scripting Language ( LSL), OpenSim Scripting Language (OSSL) and C# scripts. OS scriptengine XEngine is responsible for the compilation of the scripts down to .NET assembly before execution.
Through scripting the virtual objects can respond to the users' action. An object's behavior depending on the scripting might be moving, displaying messages or media, changing shape etc.. Anything scripted can "talk" normally at 20m, "shout" at 100m, or "whisper" at 5 meters into Nearby chat. Our game scenario requires to limit the distance to the 5 meters from the object. So, only the avatars that are in the same room with the object can interact with that.

#### 5.4.2.7. OAR function

The OpenSimulator Archive (OAR) function saves a virtual environment as it is and so as it can be reloaded in another server. These files contain the different buildings, objects, documents, multimedia data, created in the virtual worlds. They can save all the necessary asset data so that you may fully restore the terrain, region parcel data, the textures of objects and their inventories when loaded onto a completely different system using a different asset database. That means that somebody can work offline and save all the created world in an OAR file. Then, by writing one command in the server's console the whole environment can be uploaded to another computer or online.

#### 5.4.2.8 NPCs (Bots)

Non-Player Character (NPCs) are programs that can be used to control in-world avatar in an automated way. NPCs are perceived as virtual clients so they do not overload the server as if they were real users' clients. For this reason, they can be as many as the simulation/game designer needs. Such functionality can prove extremely helpful when trying to implement scenarios where the users have to interact with NPCs. Bots can also be programmed to perform in-world maintenance or administration tasks. The OS platform offers numerous NPC-dedicated OSSL functions that can be applied to create scripts that control a Bot as desired.

### 5.4.2.9. Grids and Regions

Each virtual world hosted in the OS platform might consist of one or more regions. A region is the virtual physical space of land (256x256m2) where Avatars move and interact. A region is the space that contains the virtual objects/models that can represent anything: an island, a city, a neighborhood etc. Transportation between distant regions can be achieved through teleporting.

Every region is located at predefined coordinates on a XY axis on a VW map. They can be adjacent, forming greater land masses, that is "Grid". The grid is the level that organizes the regions and their positions in the world and can be perceived as a world map. Transportation between grids might be restricted when a grid administrator does not allow hyper grid connectivity.

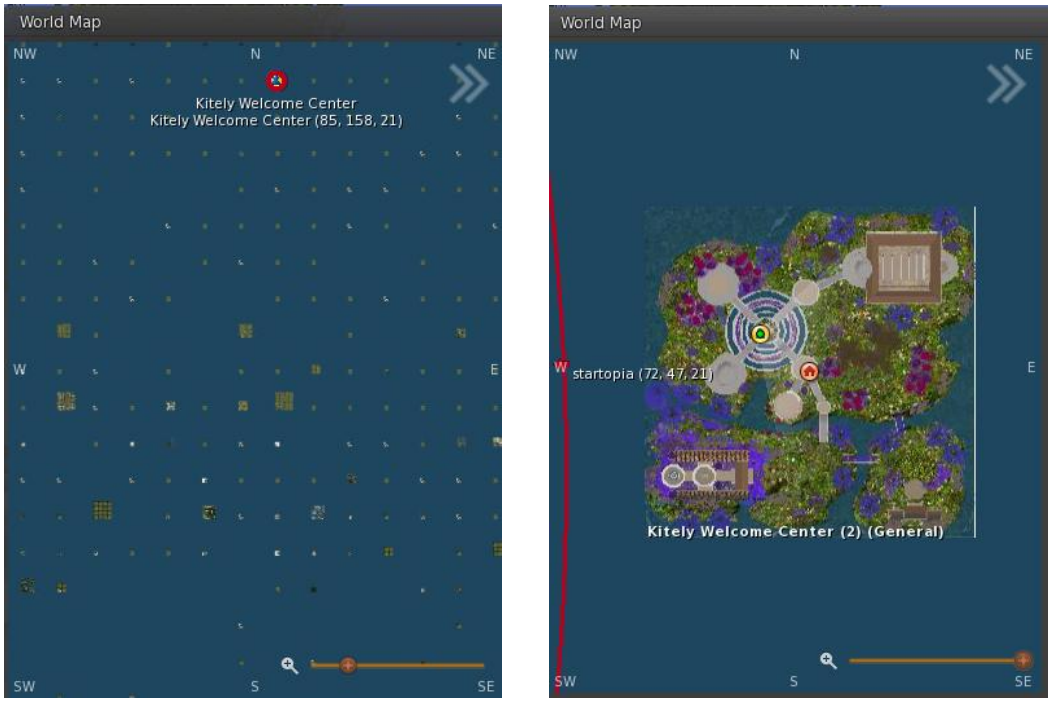



**Figure 31: Grid and Region Screenshots of the virtual world Kitely**

## 5.5. Selection of Educational Game Design Model

Our main intention is to design a game with an added educational value. To this direction, we searched for an appropriate game design model that takes into account not only gaming features but also pedagogy. The model that was closest to our expectations is

Ibrahim and Jafar's educational game design model. This game combines three factors; game design, pedagogy and learning content modelling, with emphasis on usability, multimodality, fun, problem solving and syllabus matching. (Ibrahim and Jaafar 2009)

### 5.5.1. Description of Ibrahim and Jafar's Educational Game Design Model

Ibrahim and Jafar (2009), after reviewing and comparing the few available frameworks for educational game design, that have been proposed from other researchers, suggest the "Educational Game Design Model". As Figure 32 shows the model takes into account a variety of factors ranging from game design theories, learning theories to psychological theories. This model is chosen as the basis of our game design model. However, the model is extended and enriched.

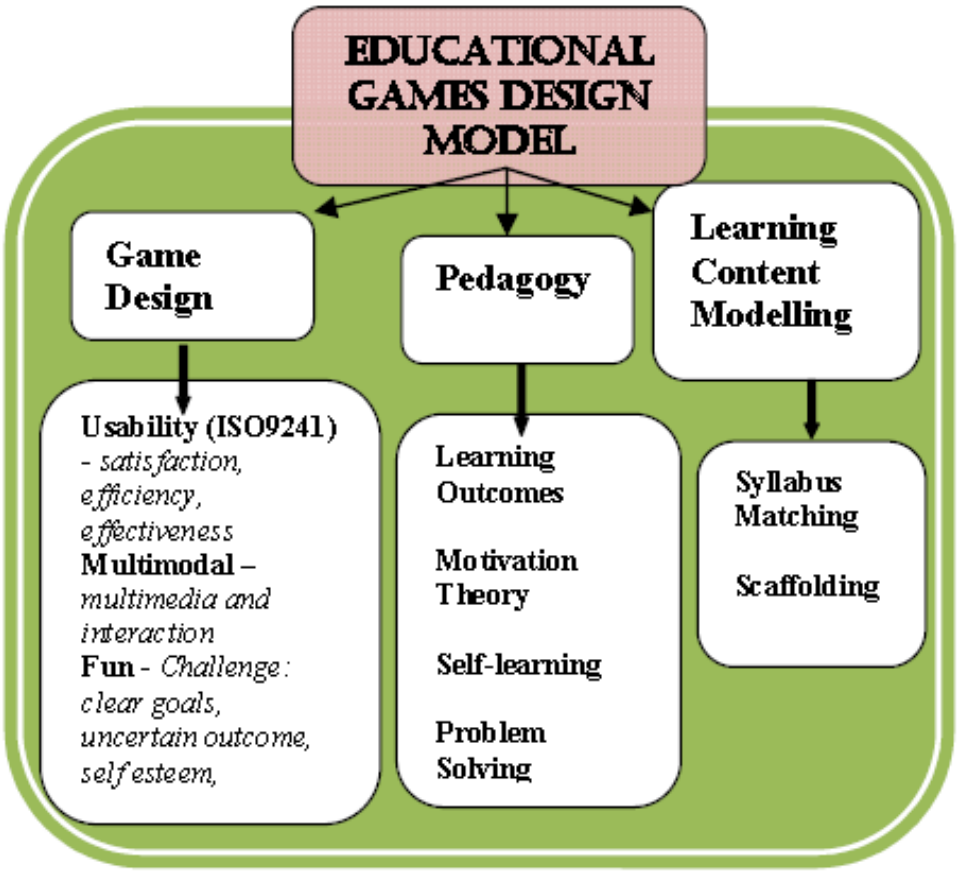



**Figure 32: Ibrahim and Jafar Educational Game Design Model (2009)**

#### 5.5.1.1. Game design

Game Design focuses on **Usability, Multimodality and Fun**. Usability relates to

effectiveness, efficiency and learner's satisfaction. **Multimodality** means that the game should combine multiple media such as audio, video, graphs, text and interaction among the learners. According to the "Educational Game Design Model" a game should also give immediate feedback on their performance. **Fun** is another important characteristic. Furthermore, an educational game, should be a game, meaning that it should be fun, frivolous, motivating, engaging and challenging. Fun comes through challenges, clear goals, the uncertain outcome of the game and the increase of the learner's self-esteem, while playing the game and achieving goals.

#### 5.5.1.2. Pedagogy

According to Jafar's model, **pedagogy** of a game puts the emphasis on the learning outcome. The game should be efficient and meet the learning objectives based on the relevant subject. It is also important to promote learners' independency and self – learning. The students must be able to play the game without the teacher's presence. Thus, constant feedback contributes to the learner's autonomy. Motivation is another important factor that boosts the learning experience. Additionally, the game should give the opportunity to the learners to gain and develop problem solving skills

#### 5.5.1.3. Learning Content modeling

**Learning Content modelling** is another important factor. The educational game should help students meet their learning objectives and achieve the learning goals. The content of the game should be relevant to the specific subjects and materials. Syllabus matching is crucial for self-learning. Finally, the game should help the learners to build their knowledge step by step (scaffolding) receiving support from the game itself.

### 5.6. Ibrahim and Jafar's Educational Game Design Model Enriched

For the proposed design model, we keep as a basis the aforementioned model and on the top of that we add new elements, especially in the game design and in the pedagogy sections. We extend the initial model to include some important game principals in order to secure the entertaining character of the game and also, some pedagogical requirements in order to ensure that the game has an added educational value.

### 5.6.1. Game Design Enriched

At this point we enrich the **game design** with the key elements that make a game, an authentic gaming experience. According to Prensky (2001) there are six key structural elements of games that increase motivation and make a game, an authentic game:

- Rules
- Goals and Objectives
- Outcomes & Feedback
- Conflict/Competition/Challenge/Opposition
- Interaction, and
- Representation or Story.

According to Sanhez (2011) the key criteria for game design are:

- Motivation through competence or co-operation and autonomy
- Content related to the learning objective
- Freedom, rules and feedback
- Endorsement of Mistakes and consideration of the emotional aspects of learning

The game principles applied to the proposed game design derive from critical review and combination of the above principles. The suggested key elements of a game are:

1. **Rules and freedom**

What differentiates a game from other kinds of play is that a game is an organized and rule- based play. Rules impose limits for all the players making the game fair and also force players to reach goals through specific paths. The rules should be clear, easy to grasp, acceptable according to the beliefs of the learner and relevant regarding the model embedded in the game. However, motivation increases when the player feels “free” to make choices and to take decisions even if this freedom is an illusion, as a game has always rules that limit this freedom. The result of the feeling free to is the increase of learner’s autonomy. The learner takes decisions and initiatives in accordance with the consequences that these might have and not in accordance with teacher’s expectations. (Sanchez 2011)

2. **Goals and Objectives**

A game has to be goal-orientated. Pushing players to achieve goals and win is something

that increases their motivation and moves them along in the game. The objectives of a game should be clear and stated at the beginning of the game.

### 3. Outcomes & Feedback

Feedback is how the player's performance and progress towards the goals is measured. Feedback comes as a response to the player's actions. Through feedback the player can get reward or help to achieve the game objectives. . Competence comes when the players have to reach goals and receive often positive feedback in order to have a clear understanding of their achievements (Sanchez 2011).Additionally, feedback increases the autonomy of the learner and the feeling that he/she can develop. Winning or losing is the traditional way of getting feedback and has strong emotional and ego-gratification implications, which is a big part of the attraction of games. However, feedback can take a variety of other forms. It might be a numerical score, a graph, an oral evaluation or help from the other players in the game or it might come through other senses as well, such as the tactile rumble felt in "force feedback" joysticks. Through this feedback learning takes place.

### 4. Conflict/Competition/Challenge/Opposition

Conflict/competition/challenge/opposition are the problems in a game a player is trying to solve. By playing a game the user is solving a problem. (Prensky, Digital Game-Based Learning 2001).The conflict can be against another player or the computer or anything that stands as a barrier to achieving the objectives of the game and this is a key element for excitement. The competition element doesn't exclude the co-operative games. These games involve a some kind of conflict, challenge or problem to solve, even if it is done through cooperation and teamwork.

### 5. Interaction

The main characteristic that differentiates edutainment and video games is interactivity. (Dondlinger 2007) An important aspect of a game is its social aspect. Not only should participants interact with the gaming environment through moving objects and characters, but also participants should be able to interact with other participants. Effective game

design should stimulate social interaction with cooperation or even competition. Additionally, a game designed in a 3D virtual environment should make good use of the environments potential. The learner should also interact with the environment.

6. **Representations or Story**

Representation means the game is about something, abstract or concrete, direct or indirect. For example, Tetris is about building and recognizing patterns. The Age of Empires is about the history of the art of war. Representation includes any narrative or story elements in the game.

7. **Content**

The content of the game should be related to the content of the lesson. The gameplay and the content should be integrated meaning that the required knowledge to succeed in the game is the goal of the learning. The game should reflect a situation referred to the knowledge that must be acquired.

8. **Emotional Aspects: frivolity, failure, mistakes**

Another dimension that should be taken into account when designing a game is frivolity. The frivolity of a serious game helps the learner feel secure. The player/learner can make mistakes without consequences in the real world and should be encouraged to make mistakes, as per learning can also come through this process. Moreover, humor, graphical environment, fantasy and curiosity have a positive impact on the learner's psychology and decrease the anxiety. (Sanchez 2011)

### 5.6.2. Pedagogy Enriched

Extending Jafar's model **pedagogy**, we include two more learning approaches in our game and some additional pedagogical requirements.

A game should follow an instructional design. Apart from the requirement for a game that is motivating and develops problem solving skills a game should be appropriate for use in

a flipped classroom. Bishop & Verleger (2013) define the flipped classroom as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. “The flipped classroom is a new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem solving activities in the classroom. It represents a unique combination of learning theories once thought to be incompatible—active, problem-based learning activities founded upon a constructivist ideology and instructional lectures derived from direct instruction methods founded upon behaviorist principles.” (Bishop & Verleger, 2013, p.1)

At the same time a game should be in line with the Bologna course reform of 1999 and the Common European Framework Reference for foreign language teaching (CEFR), according to which the teachers are increasingly expected to provide students with new tools in order to enhance autonomous learning. (Gonzalez-Pardo, et al., 2012) So, a game should aim to be played with or without the teacher.

Apart from the pedagogical approach that a game design should follow, there are some additional important pedagogical requirements that should be taken into account when designing a game. Jafar’s model is extended with these. Based on previous research we identified that the most common and most important pedagogical requirements when designing an educational game are: 1. Integration with online education 2. Adaptation 3. Assessment (Moreno-Ger, et al., 2008) and we incorporated them in our educational game design.

**1. Integration with online education**

Integrating an educational game with online learning allows the teacher to monitor the activity of the learners without necessarily being there.

**2. Adaptation**

Adaptation of an educational game allows the teacher to take into consideration the level , the individual needs and the different learning objectives of the learners. (Garrido-Iñigo

and Rodríguez-Moreno 2013)

### 3. Assessment

Assessment of the learning process is an important part of the learning experience Students do not develop declarative knowledge without reflection and debriefing. Debriefing is to become aware of the knowledge used in every situation in order to solve a problem (Sanchez 2011).This emphasizes teacher's role in helping students to construct a general image of their performance, with the negative and the positive aspects.

### 5.6.3. Overview of the suggested Game Design Model

After enriching Ibrahim & Jaafars' model (2009) with the key game principals, two more learning approaches and some important pedagogical requirements we ended up with a new model. The figures below present the initial and the proposed model.

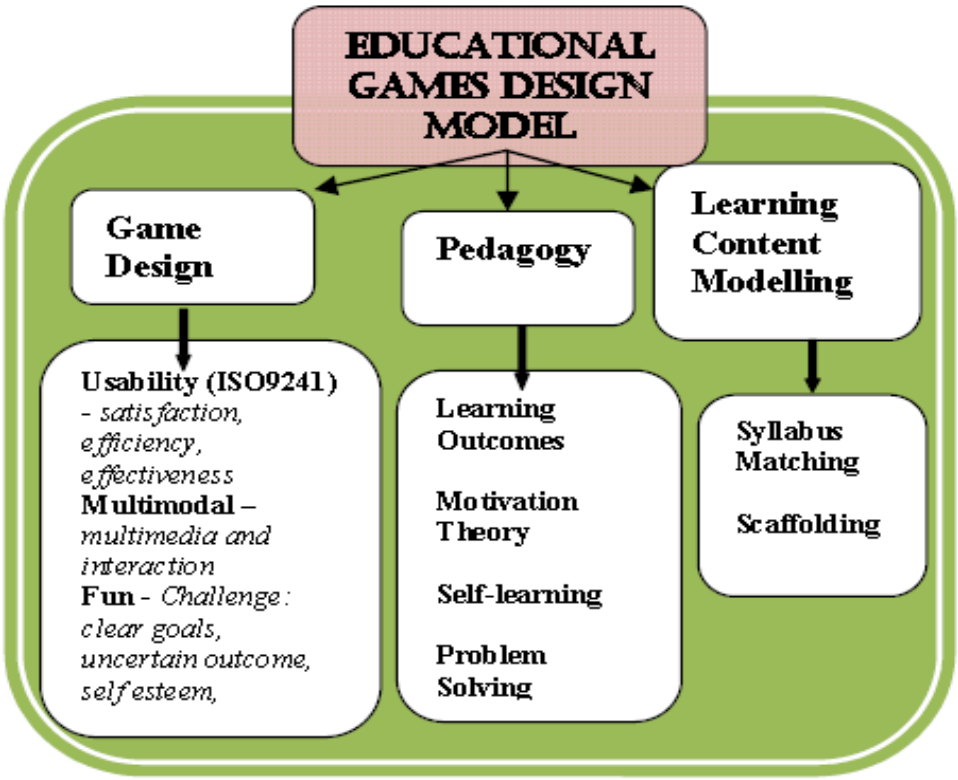



**Figure 33: The initial model**

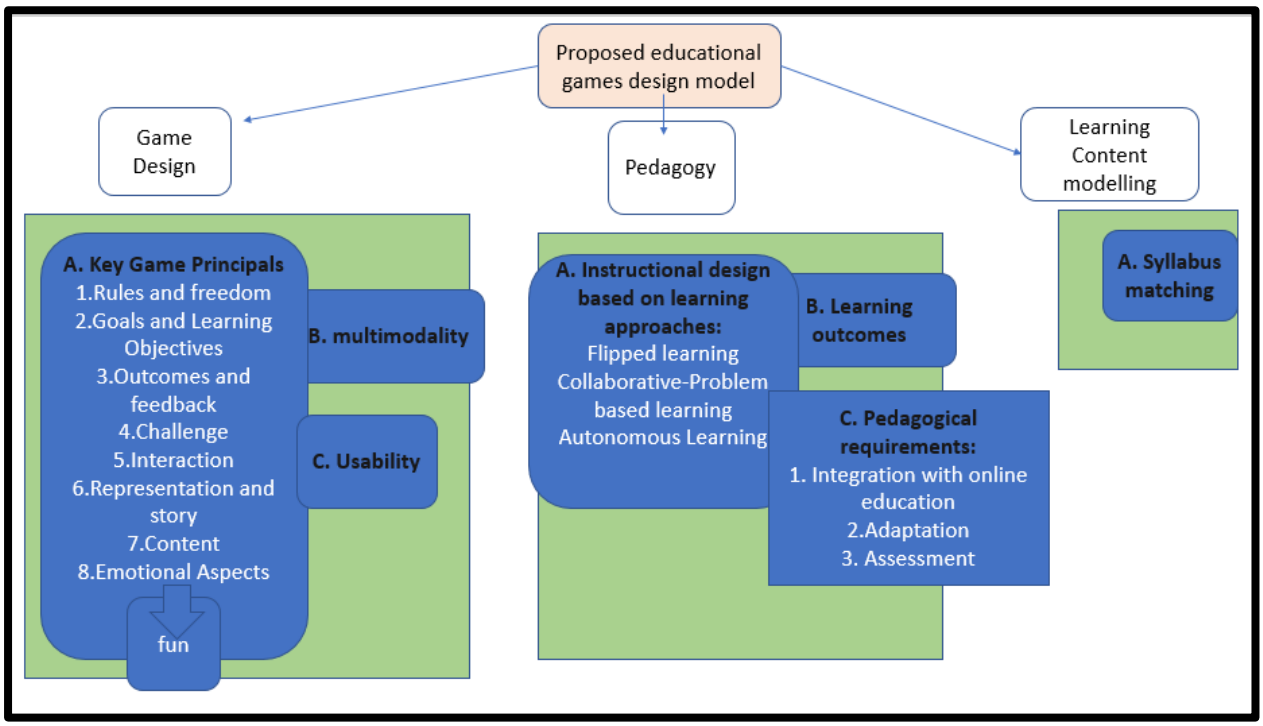



**Figure 34: The proposed model**

### 5.6.4. Applying the suggested game design model

The three factors of the suggested model are: game design, pedagogy and learning content modelling. We are going to use these and all of their components as a guideline for the design of our game.

#### 5.6.4.1. Applying the suggested game design

**Game design** focuses on following the key game principles, that lead to the feeling of fun, on Multimodality and on Usability. The game design takes into account the eight forenamed game principals:

1.Starting off, when the players log in the 3D environment they receive a notecard with the **rules** and the **goals** of the game very clearly described. Additionally, when the players try to find out and click on the right, implied objects they have the freedom to click on almost every object.

2.They also have the freedom to collaborate in many different ways: through voice or text chat and through the camera controls. However, this **freedom** is limited because they

cannot click on each other's objects and they cannot read each other's messages. The messages pop up when the objects are clicked.

3.Regarding the **feedback,** players receive continuous feedback on their performance by the system. When they do it well they receive positive feedback and when they fail they receive encouraging and helpful feedback to continue. Furthermore, each other's help and comments count as another form of feedback.

4.The game is also challenging as the players try to solve through teamwork a problem with the computer as an opponent. It can also be more **competitive** if it is played by different quartets of learners who compete for the best time of escaping the room.

5.Another key element of a game is **interaction** among players. Continuous interaction and cooperation is the core requirement for playing the designed game. Interaction among players is an essential part of the game. The players can use voice or text chat to communicate. Moreover, not only interaction among learners occurs but also interaction with the environment itself.

6.Furthermore, the game unfolds around a **story,** based on historical facts.

7.The **content** of the game is absolutely tight to the learning objectives. The players have to use the required knowledge to succeed in the game.

8.Finally, **emotional aspects** are taken into account. The graphical design of the game attempts to immerse the players in a roman style environment. Mistakes and failure are not punished. They can make uncountable mistakes without serious consequences. This is the reason why the game has no time limit. They can play it for as long time as they need. The final step of the game demands some alertness as the players have only 30 seconds to escape the room, before the door is locked again. However, they can repeat the final step infinite times.

Additionally, the designed game satisfies the requirements for **multimodality** and

**usability** as the technical knowledge needed to play the game is limited. As long as the players know how to move around in the 3D environment and how to use the camera control, they can play. Also, the game combines multiple media such as audio and text.

#### 5.6.4.2. Applying the suggested pedagogy

The pedagogy of a game focuses on the instructional framework, the learning outcomes and the pedagogical requirements.

The designed game aims to be an effective educational resource for flipped learning. "Escape Domitian" game aims to give to the learners an opportunity to "use" their knowledge and have a hands-on experience regarding the Latin language. They can play that game without the mandatory presence of the teacher resulting to the increase of their autonomy. The game can be used either as a material for independent learning, without the presence of the teacher -but with the potential to track students' performance or as an in-class activity in presence of the instructor. Before they play the game, the students are supposed to study and come ready to practice in the classroom

Regarding, the pedagogical requirements "Escape Domitian" is a game that can be hosted in a server and uploaded **online.** The students can catch up online to play the game without the mandatory - online or physical- presence of the teacher. At the same time Opensim technology allows the teacher to monitor the student's activity. Moreover, the game provides teachers and administrators with the possibility to modify and **adapt** the program, in line with the teaching purposes and students' individual needs. Finally, the platform in which the "Escape Domitian" is built, allows monitoring student activity and monitor all relevant events in order to generate useful information regarding the player's' behavior. As a result, the teacher could detect individual learner problems and focus specifically on these problems (Berns, González-Pardo &Camacho, 2011) and **asses** their performance. For example, the teacher can find out how much time the students needed to complete the task, how many objects did the clicked, how many times did they click on wrong objects etc.

#### 5.6.4.3 Applying the Learning Content modelling

The game content is absolutely tailored to the subject taught. The game is based on the Latin vocabulary the players need to acquire. In order to achieve the game objectives, they have to achieve the learning objectives. The game aims to give an opportunity for practicing on the Latin Vocabulary related to common objects and furniture found in a house. The figures above show the related vocabulary.

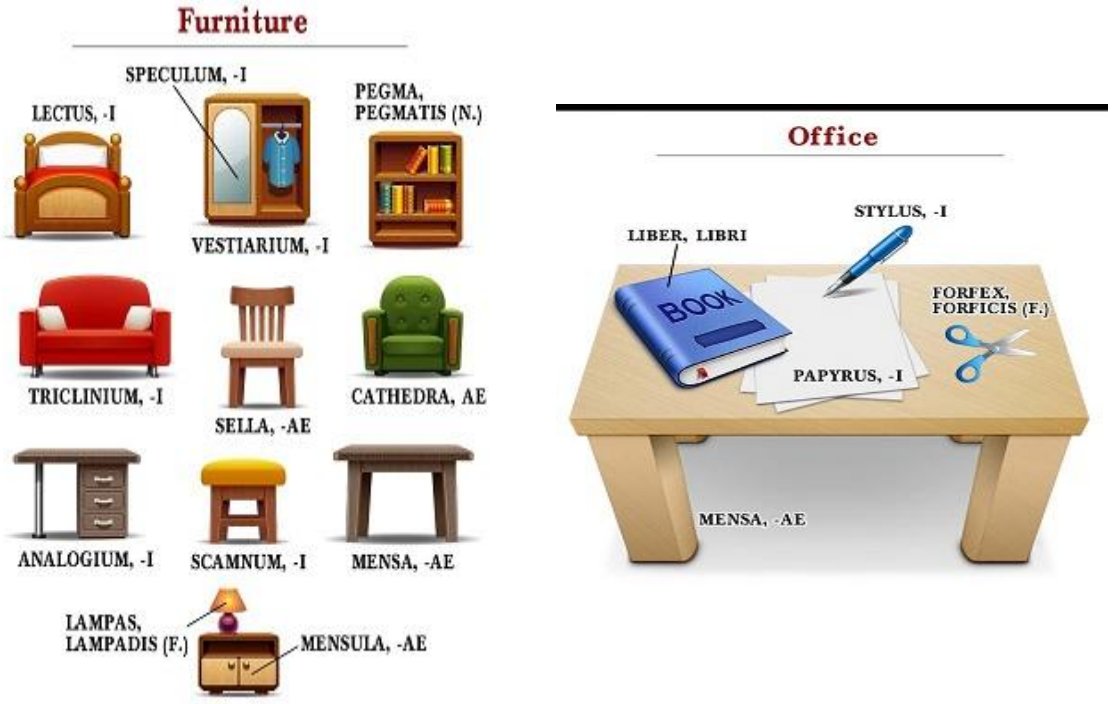



**Figure 35. Vocabulary for home furniture**

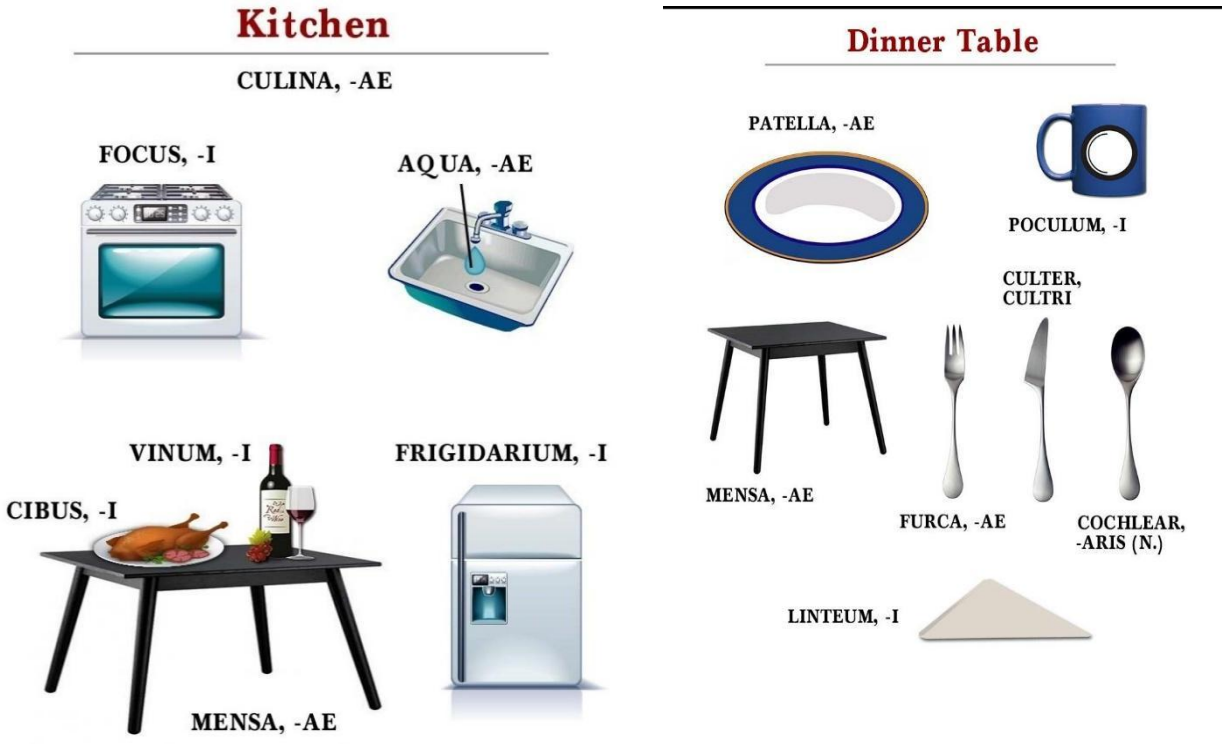


**Figure 36. Vocabulary for Kitchen**

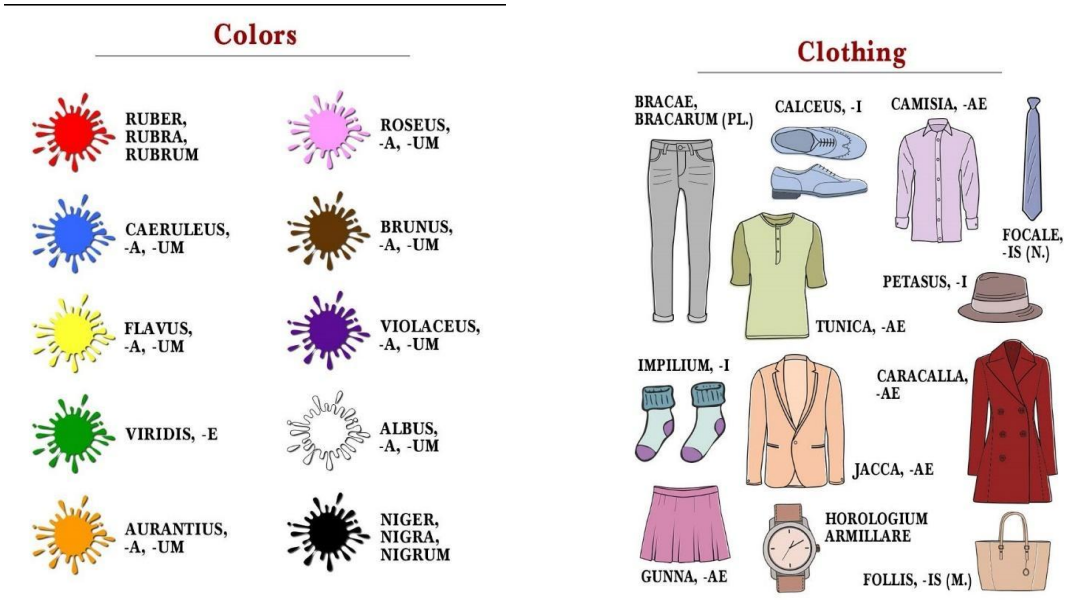



**Figure 37. Vocabulary for Colors and Clothing**


**Figure 38. Vocabulary for Bathroom**

The learning objectives of the game are:

- to determine their meaning of the worlds using a variety of strategies (e.g., prior knowledge, context clues, group discussion, media sources)

- to acquire and enhance understanding of vocabulary by making connections to related ideas and simulations

- to take decisions and evaluate the decisions of the other players

- to use the vocabulary in order to receive and give feedback

- to use new vocabulary in speaking and writing

- to apply the knowledge on a realistic environment

**5.7. Summary**

In summary, this unit described the preliminary work before the design of our game, namely the educational approach and the platform of selection and the game design model we are going to apply.

More specifically, we are going to design an educational game from scratch in order to meet the requirements of the game. This game will be developed on the OpenSim platform, the platform we selected in accordance to the we criteria set. OpenSim is an open source and free technology with a very rich environment and tools for 3D creation.

The popularity of the platform and its similarity and compatibility with Second Life (the most popular platform) make the platform very appealing, bearing in mind that there is a large educational and helpful community for the later and loads of information on the internet.

At the broadest architectural level the main components of OpenSim system are three: a) the server (or "simulator"), b) the client (or "viewer") and c) the services (Maratou and Xenos 2014). Among the exceptional features of OpenSim are the built-in editor, the potential to backup and download locally everything created, the self-hosting option, the control of your content, the OpenSimulator Archive (OAR) function that saves a virtual environment as it is and so as it can be reloaded in another server, the scripting of the objects, the high level customization of the avatar and the hypergrid connectivity, that allows teleporting from one world to another without creating new avatar or account.

After selecting platform, we proceeded to the selection of an appropriate educational game design model taking into account previous studies which indicate that educational games should include game design and good pedagogy in order to ensure learning effectiveness. The model that was closest to our expectations is Ibrahim and Jafar's educational game design model. This model combines three factors; game design, pedagogy and learning content modelling, with emphasis on usability, multimodality, fun, problem solving and syllabus matching. (Ibrahim & Jaafar, 2009). Upon this model, we built and propose a new one, enriched model. We extend the initial model to include some important game principals in order to secure the entertaining character of the game

and also, some pedagogical requirements in order to ensure that the game has an added educational value.

The game design is enriched with 8 key elements that make a game, an authentic gaming experience creating a sense of fun. These are: rules and freedom, goals and learning objectives, outcomes and feedback, challenge, interaction, story, content and emotional aspects. The pedagogy is adjusted in order to serve the principles of collaborative, flipped and autonomous learning. In addition, three pedagogical requirements are added to secure the added value of the game. The game will be integrated with online education, will offer opportunities for adaptation to the students' needs and level and will allow monitoring students' activity in order to generate useful information regarding their behavior. As a result, the teacher can assess the learner's' performance. Finally, in order to achieve the game objectives, the students have to achieve the learning objectives.

# 6.The "Escape Domitian" game

## 6.1. Introduction

Unit 5 described all the preparatory work before the design of the game: selection of educational game design approach, selection of platform and educational game design model. The result of this attempt is the so called "Escape Domitian" game. This unit presents and describes thoroughly the game developed, the "Escape Domitian" game.

More specifically, section 6.2. attempts to categorizes the game, section 6.3. states the mission of the game, section 6.4. give details about the game scenario, section 6.5. explains how to play the game, section 6.6. pictures the player's and system's interactions and section 6.7. presents the environment of the game. Finally, section 6.8. draws some conclusions regarding the creation of the game.

## 6.2. Categorization of "Escape Domitian" Game

A serious game is a game in which education is the primary goal rather than entertainment (Michael & Chen, p36, 2006). This definition underlines the fact that the

games are not in conflict with the education but can co-exist completing each other. According to Zyda a game focuses on the story, the art and the software. The additional component of a serious game is the pedagogy of the game (Zyda, 2005).

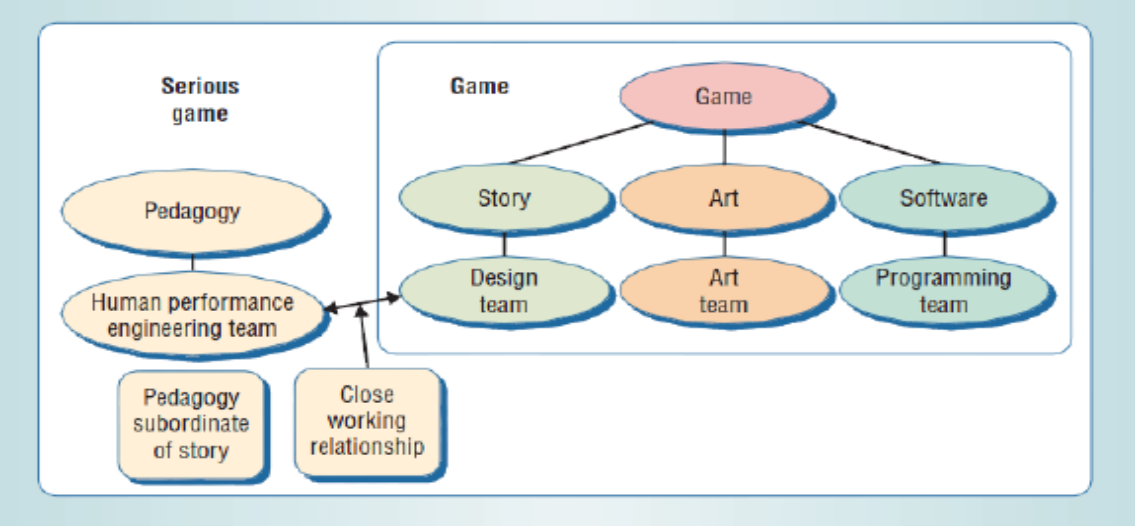



**Figure 39.From game, to serious game (Zyda, 2005)**

A serious game takes into account learning approaches, objectives and students' needs. According to Michael et al. (2006) serious games can be categorized as below:

- Military games
- Government games
- Educational Games
- Corporate Games
- Healthcare Games
- Political Games
- Religion Games
- Art Games

According to Prensky (2001) games are generally recognized as falling into one of 8 "genres," which often overlap. These are:

- Action
- Adventure
- Fighting
- Puzzle

- Role Playing
- Simulations
- Sports
- Strategy

The designed game belongs to the serious, educational cooperative games and it could be further categorized as a problem solving and role playing game.

### 6.3. Mission of the Game

The game “Escape Domitian” aims to provide an effective, engaging, entertaining and immersive learning experience. The purpose of the game development aims to cover a gap in this field and offer an innovative experience to the learners of Latin language.

### 6.4. Game Scenario

Domitian (ruled AD 81–96) is one of the bloodiest roman emperors in history. He suffers from deep suspicion of those around him, amounting to paranoia, possibly a result of his narrow escape from being killed during the civil war. He is particularly suspicious of the Senate and has a number of leading citizens executed for conspiracy against him. This paranoid behavior leads to cruelty and executions, a real “reign of terror" for the members of Senate and for the citizens who are against him.

As members of the Senate the players are accused of conspiracy and then locked up in their own house. From any moment, the guards might come to execute them. They must help each other and find the way to escape.

### 6.5. Instructions of the game

This is a collaborative, role play game for 4 people. Each player is locked up in a different room of the house: in the living room, in the bathroom, in the bedroom, in the kitchen. The players must collaborate to find the key and escape altogether from the house before the guards come. They have to do the following actions:

- Teleport in one of the four rooms by clicking on one of the landmarks on the notecard given at the beginning of the game.

- Find and click the right object based on the description given by the notecard. Pay attention to the feedback given.

- Share with the other players through voice or text chat the information displayed by that object. The description given is about an object located in one of the other three rooms. They don't need this info but one -only one- of their co-players needs it to find the right object.

- Click on the right object based on the description given by one of their co-players. Repeat step 2 and 3 till the final challenge, that will give them the key.

- Take the key and walk to the front door. All the players should find their way to the front door. All of them lose, if one loses! The door unlocks only with a password that they have to find collaboratively.

At the same time the players should use the Vocabulary boards. They can find them on the external wall, in the garden and also in their inventory. They should also help each other through the voice/text chat and the camera control (everybody can see each other's room but cannot interact with the objects there) to understand and find the implied object.

### 6.6. Overview of player and system interaction

The steps needed for the game completion could be summarized and visualized in the Figure above. Figure 40 presents the action of the player and of the system. The lines that are on the same level show an action- reaction situation.

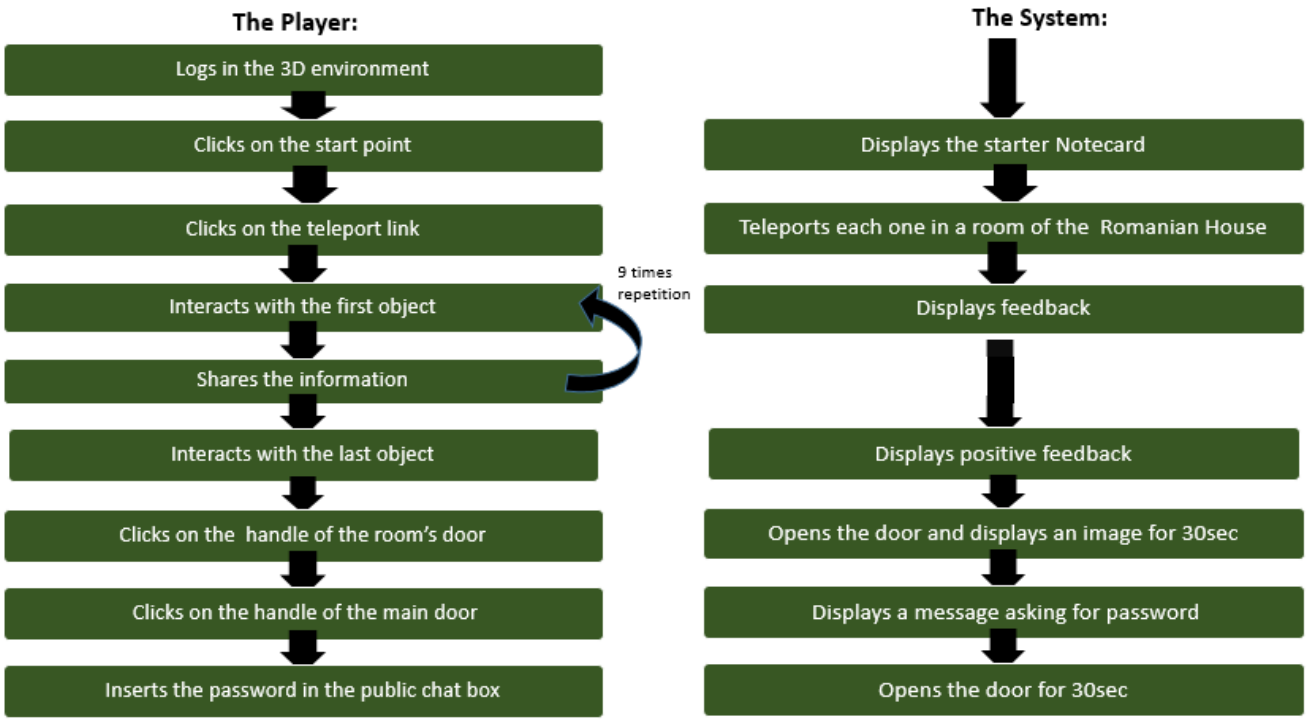



**Figure 40. Player and System interaction**

## 6.7. The Environment of the game

### 6.7.1. Start point

The 4 players log in the 3D virtual environment. They find themselves trapped in a roman's house yard. On the walls, they can find on big board the vocabulary sheets they are going to use.


**Figure 41 : The yard of the Romanian house and the start button**

When they click on the “start here” button they receive a notecard. The notecard includes:

- information about the game scenario
- instructions and rules of the game
- 4 links that teleport them to the rooms
- 4 vocabulary sheets
- the Latin description of the first object they should click in their room

The note card must be saved in their inventory so they can use it during game playing. The most important about the notecard is that the players can refer to the vocabulary sheets any time they need it during the game by clicking on the links on it.

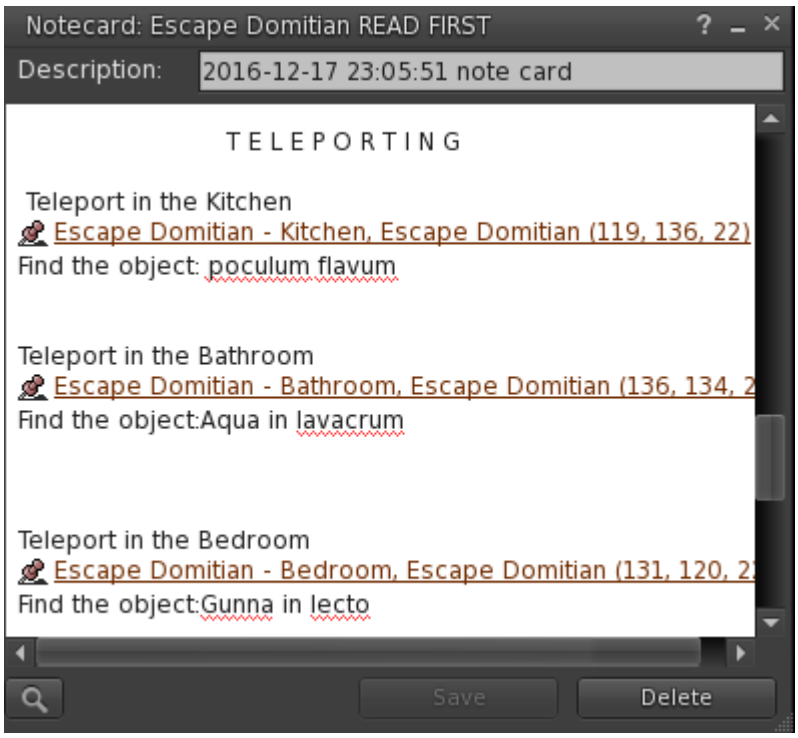



**Figure 42: Landmark links on the Notecard**

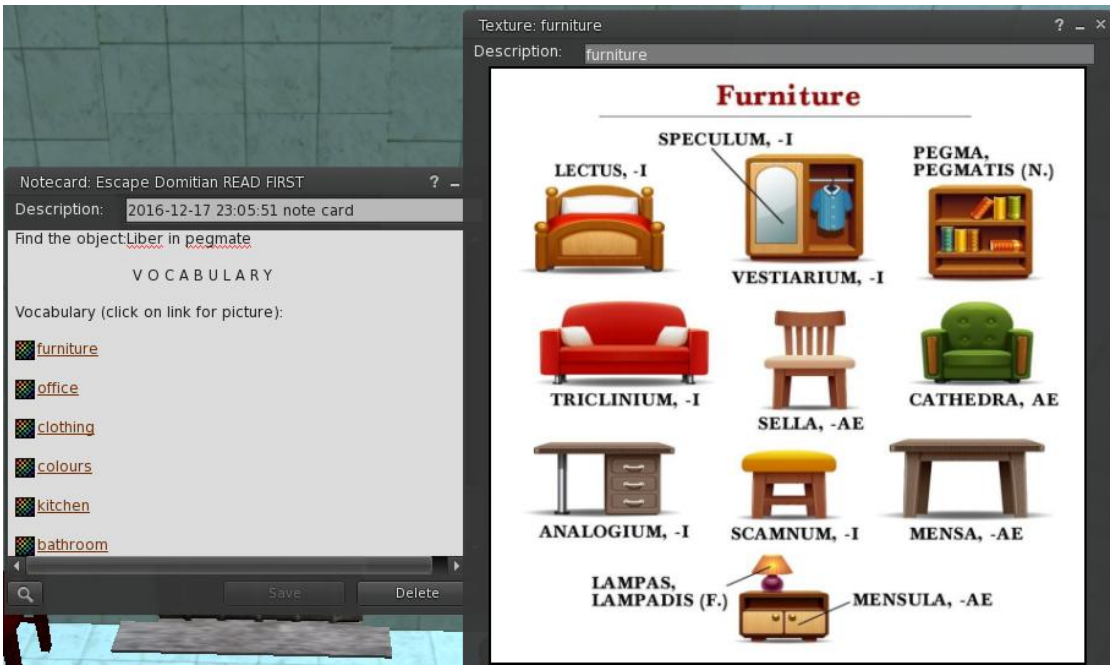



**Figure 43: Vocabulary links on the Notecard and pop-up vocabulary sheets**

### 6.7.2. Rooms

After teleporting each player is trapped in a different room of the same house. The game

starts when each player clicks on the first described object. For example, an object that must be clicked in the kitchen is “flores rubri” (red flowers). The other rooms (all of them or at least one more room) have also flowers but in different color just to confuse the players and make the game a bit challenging. So, they player needs to understand the whole phrase and not only the color or the object. The game consists of 10 steps for every player in order to find the key of the room and unlock the door. In each step the player clicks an object of his/her room. In response, the system displays a message with new information about the next object that should be clicked. Then the system displays a message with the description of the next implied object. In total, there are 40 objects, 10 for each player.


**Figure 44:Bathroom**


**Figure 45:Kitchen**


**Figure 46: Bedroom**


**Figure 47: Living room**

When the objects are clicked, the system displays messages in Latin language that ask from the player to find and click several objects located in the room. When the new object is clicked, a new message appears in Latin. It must be shared again with the co-players. Each message is useful only for one player. The descriptions included are unique for the correspondent room. The combination of the location and/or the color of the object make it unique for each room. The message that each player gets must be shared with the other players through the public chat box. All the players should continuously exchange information. If one player is stacked, then all the players are stacked and they game cannot be continued unless they help each other to find the hidden messages.

In case the player clicks on the wrong objects the system gives feedback to the player and provides a piece of advice. In a similar way, when the players click on the right object they receive positive feedback. As the pictures show the feedback is displayed in the public nearby chat and on the screen as well. The player can choose the desired way.

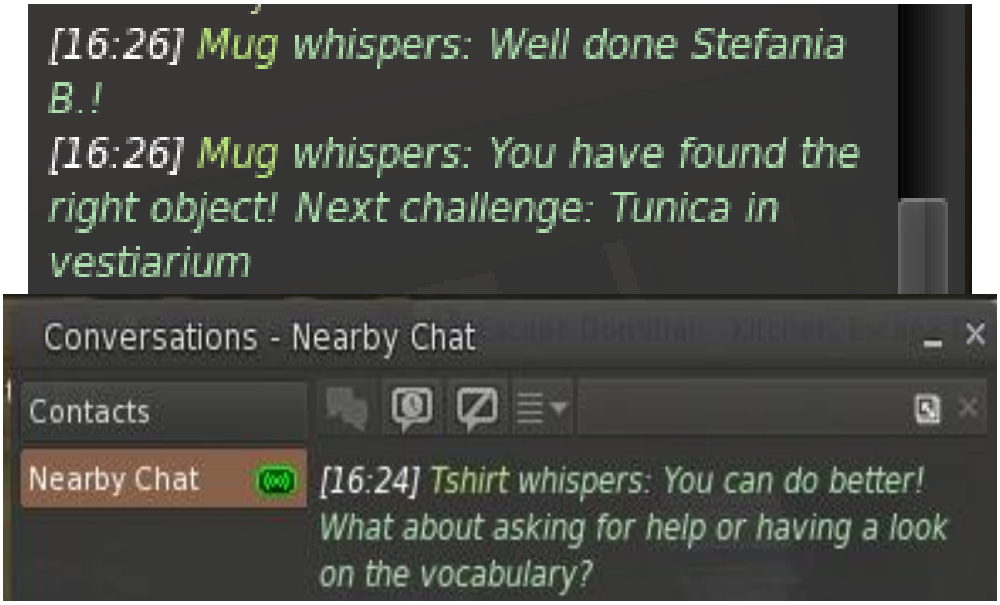



**Figure 48: Positive and negative feedback displayed in the public chat box**


**Figure 49: Feedback displayed on the screen**

At this point the camera control feature is extremely useful because through this the co-players can provide written or orally help and feedback to each other. Through the camera controls they can watch each other's room from different point of view and they can help each other through text or voice chat to find the implied object. However, they can only interact with the objects that are located in their room.

### 6.7.3. Hall

The 9$^{th}$ step is a bit tricky. When the 9$^{th}$ right object of each room is clicked, the system displays an image in the wall of every room and the door-if clicked on the handle- Is

unlocked for 30 seconds. After 30 seconds the door is locked again, and the picture is invisible.

**Figure 50: Locked door**

**Figure 51: Unlocked door and displayed image on the wall**

### 6.7.4. Main Door

The players can now exit their rooms and walk to the main door. But there they have to face a game reversal! They are not free yet. The main door unlocks only with a password they have to write in the public chat.

**Figure 52: The main door of the house and the message displayed in the nearby chat when the handle is clicked**

What they have to do is to return to their rooms, to click again on the last object from outside and open the door and make the picture visible for another 30 seconds. The players get in total 4 images at the same time.

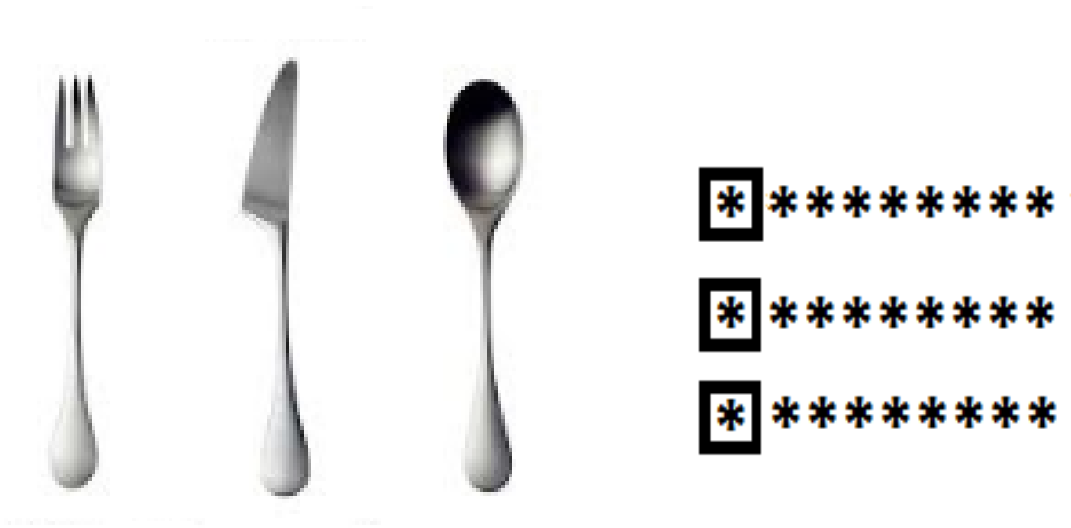



**Figure 53: The images displayed on the room walls**

They have to share them and try to "solve" the puzzle. For every pair of images (they should find which images create the pair) they have to insert the missing letters in the place of the asterisk in the square. For the first pair, they have to insert the initials of the Latin words for the colors of the flowers (**A**urantius, Caeruleus, Violaceus) and for the second pair the initials of the Latin words for cutlery (Furca, Cutler, Cochlear). So, the solution for pair 1 is: A C V and for the Pair 2 is: F C C .Once the correct password is inserted: ACVFCC the door opens for 30 seconds. They have to leave the house quickly! If they do not do it on time, they click on the door again and insert the password in the chat box. There is no limit of trials.


**Figure 54: The door unlocks once the players insert the correct password**


**Figure 55: The view outside the house**

### 6.8. Conclusions

In order to create an effective educational game in a 3D virtual learning environment we followed a game design model, that sets technological and pedagogical requirements. “Escape Domitian” a is the result of this attempt. The game belongs to the serious, educational cooperative games and it could be further categorized as a problem solving and role playing game. Mission of the game is to offer an engaging and entertaining experience to the learners of Latin language and an opportunity to use the language in a collaborative game.

The “Escape Domitian” game is based on historical facts, that might give a sense of realism and consequently a sense of immersion. The 3D immersive environment of the game aims to give a sense of being there in another era. There are also clear objectives and instructions given at the beginning of the game. The game rules are simple and easy to grasp. The students interact with each other and with the environment in a repetitive process. The system responses to the player's’ actions, gives feedback and moves on the game. The players should collaborate and help each other from the beginning to the end. If one loses everybody lose.

Regarding the technical background of the game, OpenSim, the platfrom of selection , has rich features that facilitate the game development. Creating an educational game in a virtual learning environment using OpenSim platform was a creative process. The potential of running our own grid using the computer as a server was a convenient solution. During the creation of the environment we did not face big difficulties. However, building in terms of modeling can be a time-consuming process. The most challenging part for an unexperienced user is the scripting of the objects. At this point, we would like to refer the significant contribution and help of other members of the virtual community to the game modelling and scripting.

The added value of the designed game comparing to the existing game style activities is its innovative character. More specifically the “Escape Domitian” game:

- is based on a complete game design model
- is based on the principles of authentic games
- applies a specific instructional framework
- promotes real time, multi user-collaboration in a group of students and not only in pairs
- provides learner-learners, learner-teacher and learner-environment interaction
- justifies the use of a 3d virtual environment making use of the virtual space
- can be played with or without a teacher promoting autonomous learning
- can support flipped learning
- can be played by anyone who is interested in the Latin language and has zero knowledge

Summarizing, the good use of the 3D virtual space, the multi user and collaborative character of the game, the fact that it fulfils pedagogical and technological requirements as well, the clear learning objectives and the game scenario make it promising.

# 7. Conclusions and future work

## 7.1. Conclusions

Teaching and Learning a Language in a 3D Multi User Virtual Environment of general purpose is a very interesting, emerging field that becomes even more exciting as it is practiced all over the world without boundaries and limitations. The first objective of this project was to map this new field. To this end, 32 research cases that used 3D MUVE environments for blended or distance synchronous learning were studied. The second objective was to create a 3D educational game in this environment for Latin language learners. The nature and the features of this environment gives opportunities for innovative and creative ways of teaching and we expect this attempt to be one of them

The general consensus from the cases' investigation is that 3D MUVE's provide a suitable complementary environment for language learning and practicing speaking, listening, writing, reading skills in a constructivist framework. The features of the virtual worlds allow the construction of the knowledge through collaboration and problem solving and offer possibilities of interaction with the environment, the objects and the other community members through avatars. The majority of cases indicate that 3D MUVEs include a variety of tools and activities that support communication and interaction. Among the benefits outlined the most frequently referred are the improvement of the students' performance and the positive psychological impact that is related to the learning outcomes.

On the other hand, according to the literature a number of problems were observed during 3D MUVE's usage in the examined cases. The most important issues were related to technical problems with the hardware or the software, to the lack of students' gaming experience, to the insufficient learning results due to several reasons and to the privacy and safety of the public spaces. This is an important aspect, bearing in mind that creating private, secure environments is time and money consuming.

An observation we made based on the literature review is that despite the fact that there are many impressive 3D virtual language learning environments there is a lack of 3D

designed educational games and innovative activities for language learning in them. In addition, most of the researches test repetitively the potential of the environment to foster communication based on communication activities (e.g. role play) putting aside the collaborative nature of the medium. The few game style activities detected do not promote the collaboration in a team but in pairs.

Also, they do not make full use of the potential of the 3D environment. Activities that do not use the virtual space or the multi user and collaborative capabilities of the platform were often detected. Furthermore, it seems that there is a bigger emphasis on the modelling of the objects and of the environment instead of the lesson modelling and the pedagogical frame. Finally, some educational activities are presented as "educational games" while they do not have the attributes that an educational game is supposed to have.

As a response to this lack we suggested a 3D collaborative game for teaching and learning Latin in a MUVE. After selecting the OpenSim platform, we proceeded to the selection of an appropriate educational game design model.The added value of the designed game comparing to the existing game style activities is its innovative character. More specifically the "Escape Domitian" game:

- is based on a complete game design model
- is based on the principles of authentic games
- applies a specific instructional framework
- promotes real time, multi user-collaboration in a group of students and not only in pairs
- promotes learner-learners, learner-teacher and learner-environment interaction
- justifies the use of a 3d virtual environment making use of the virtual space
- can be played with or without a teacher promoting autonomous learning
- can support flipped learning
- can be played by anyone who is interested in the Latin language and has zero knowledge

Summarizing, the good use of the 3D virtual space, the multi user and collaborative character of the game, the fact that it fulfils pedagogical and technological requirements as well, the clear learning objectives and the game scenario formulate a promising game concept.

Concerning the process of the game creation this project pointed out how time consuming can be to create a 3D game in a MUVE from the very beginning. Especially the modelling of the objects and the building of the sim require a great amount of time. Once the stage of building has been passed the scripting of the objects can be time consuming as well and demands some scripting knowledge, discouraging the wide usage of the environment. At this point, the importance of selecting a platform with a large community of users and free repositories of models was revealed.

In conclusion, the creation of an effective educational game should include game design and good pedagogy in order to ensure learning effectiveness. The game design model we used helped us keep a balance between gaming and learning.

### 7.2. Future Research

It is acknowledged that this study still presents several limitations. The conclusions we draw are based on the investigation of 32 study cases. Although they are very carefully selected and according to specific criteria they still pose barriers that do not allow generalizations of the results. First of all, the research on this field is mainly shared by two countries (Spain, Taiwan), it's mainly orientated to teaching four languages (English, Spanish, German, Chinese) based on one learning approach and is mainly conducted with small samples of participants (under 30) between 18 and 25 years old. So, larger samples of participants should be examined.

In addition, the role of the teacher is not investigated enough. It is noteworthy, that only in one case the instructor participated in the creation of the activities. Furthermore, the activities that take place in the majority of the studies focus on the communication skills and their findings are clearly positive. However, there is not much research regarding the collaborative and problem solving skills and under which conditions they can be

promoted. At this point, it is important to underline that there are only game style activities tested and not games. Some future research questions could be:

- Can these environments motivate students to learn ancient / classical languages?
- Is the usage of these environments appropriate and beneficial in the secondary education?
- What is the most efficient learning approach for these environments?
- Which are the best strategies to be adopted to enable language instructors to use the 3D MUVE? How can more educators be involved?
- Under which conditions can 3D educational games foster collaborative skills? What is the most effective usage of the 3D MUVEs? What strategies and what activities are most effective for language learning?

Regarding the designed game there are some omissions. The game could be enriched with robots with embedded audio files to provide learners with more opportunities for meaningful interaction with the environment. We could also design more game levels according to the learners' different needs, to integrate score system and count down timer.

Additionally, we could assess and measure the usability and the acceptability of the technology we propose using a reliable technology acceptance model. Moreover, we could test the game itself and compare the results of our empiric research with those of a control group.

Finally, the log files that save the students' behavior could be further explored using learning analytics models that could make a significant contribution to understanding the large amounts of educational data. Statistical, filtering, and mining tools should be used in a way that can help learners, teachers, and institutions to achieve their analytics objectives without the need for having an extensive knowledge of the techniques underlying these tools.

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# Appendix A: Overview of the Literature Review

## A.1 The 32 study cases included in the literature review

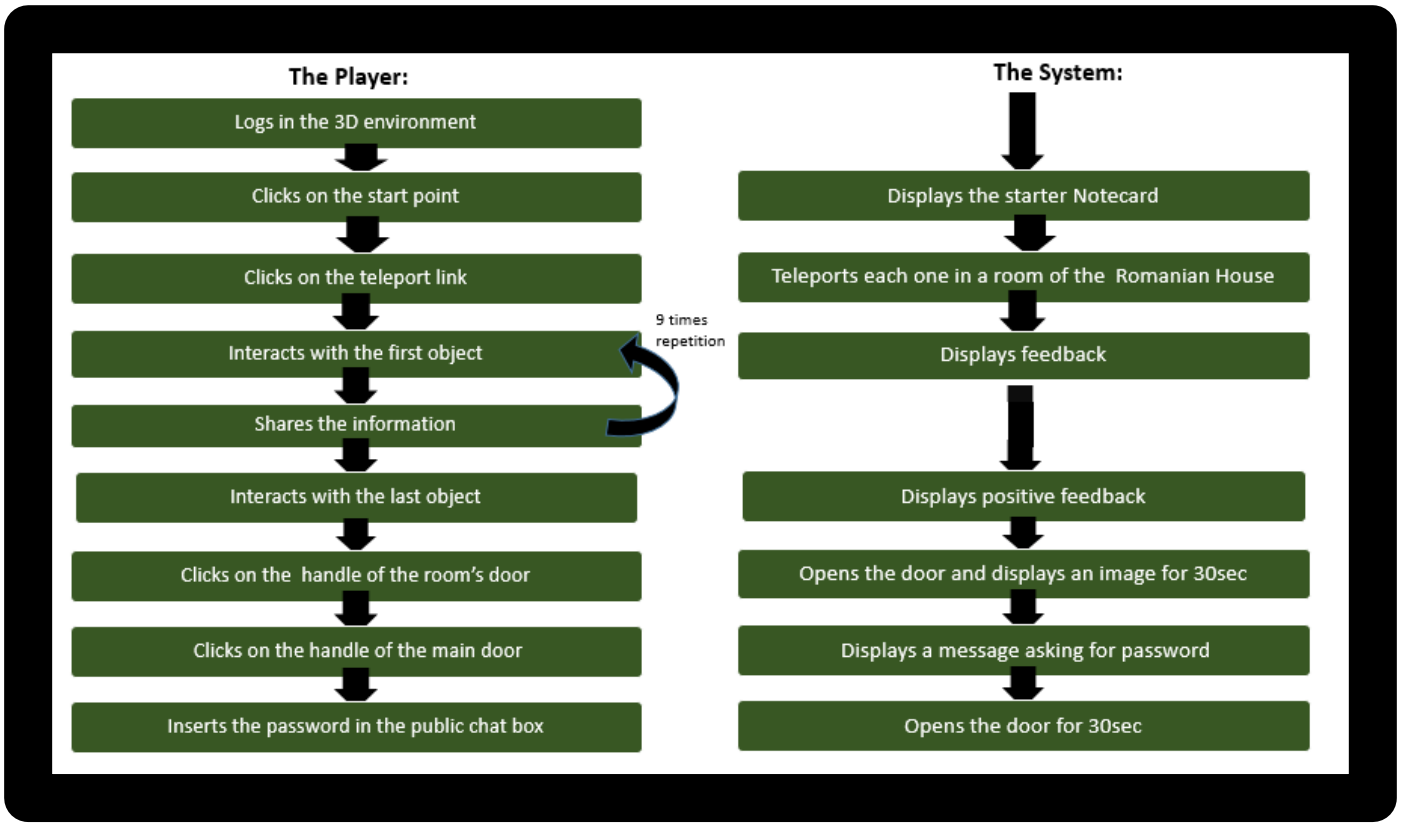
| Identifier | Source | Target Language | Platform | Research's Country | Year | Type of publication |
|---|---|---|---|---|---|---|
| **C1** | (Wehner, et al.) | Spanish | Second Life | USA | 2011 | Journal |
| **C2** | (Lin, et al.) | Chinese | Second Life | Australia Taiwan | 2014 | Journal |
| **C3** | (Grant, et al.) | Chinese | Second Life | Australia | 2014 | Journal |
| **C4** | (Kan, et al.) | Chinese | Second Life | Taiwan | 2010 | Conference Proceedings |
| **C5** | (Berns, et al.,) | German | Open Sim | Spain | 2011 | Conference Proceedings |
| **C6** | (Canto, et al.) | Dutch, Portuguese, Spanish | Second Life | Netherlands | 2013 | Journal |
| **C7** | (Sung, et al.) | Chinese | Second Life | Taiwan | 2015 | Journal |
| **C8** | (Atkins & Gaukrodger) | English | Second Life | New Zealand | 2013 | Conference proceedings |
| **C9** | (Chung) | English | Second Life | Taiwan | 2012 | Journal |
| **C10** | (Braun & Slater) | Mixed | Second Life | UK | 2014 | Journal |
| **C11** | (Knutzen & Kennedy) | - | Second Life | Hong Kong | 2012 | Journal |
| **C12** | (Chiang, et al.) | English | Second Life | Taiwan | 2014 | Journal |
| **C13** | (Liou) | English and other | Second Life | Taiwan | 2012 | Journal |
| **C14** | (Milton, et al.) | English, Greek, | Second Life | UK | 2012 | Journal |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Hungarian | | | | |
| **C15** | (Berns, et al.) | German | Open Sim | Spain | 2013 | Conference Proceedings |
| **C16** | (Peterson) | English | Wonderland | Japan | 2012 | Journal |
| **C17** | (Oh, Nussli) | English | Second Life | USA | 2014 | Journal |
| **C18** | (Berns, Pardo, Camacho) | German | Open Sim | Spain | 2011 | Conference paper |
| **C19** | (Deutschmann & Panichi) | English | Second Life | Sweden-Italy | 2009 | Journal |
| **C20** | (Lan, et al.) | Chinese | Second Life | Taiwan | 2013 | Journal |
| **C21** | (Berns, et al.) | German | Open Sim | Spain | 2013 | Conference Proceedings |
| **C22** | (Lorenzo, et al.) | Spanish | Open Sim | Spain | 2013 | Journal |
| **C23** | (Peterson) | English | Second Life | Japan | 2010 | Journal |
| **C24** | (Tamai, et al.) | Japanese | Second Life | Japan | 2011 | Conference Paper |
| **C25** | (Neville) | German | - | USA | 2015 | Journal |
| **C26** | (Collentine) | Spanish | Unity game | USA | 2011 | Journal |
| **C27** | (Berns, et al.) | - | Open Sim | Spain | 2013 | Conference Paper |
| **C28** | (Czepielewski, et al.) | English, German, Spanish | Open Sim | Lithuania, Greece, Germany, Poland | 2011 | Conference Paper |
| **C29** | (Dalton, G., & Devitt, A.) | Irish | Open Sim | Ireland | 2016 | Journal |
| **C30** | (Inigo, Rodríguez-Moreno) | French | Open Sim | Spain | 2013 | Journal |
| **C31** | (Ibáñez, et al.) | Spanish | Open Wonderland | Spain, USA, Tunisia, Latvia | 2011 | Journal |
| **C32** | (Blasing) | Russian | Second | USA | 2010 | Journal |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Life | | | |

# Appendix B: Modelling the steps of the Game

## B.1 Player and System Interaction

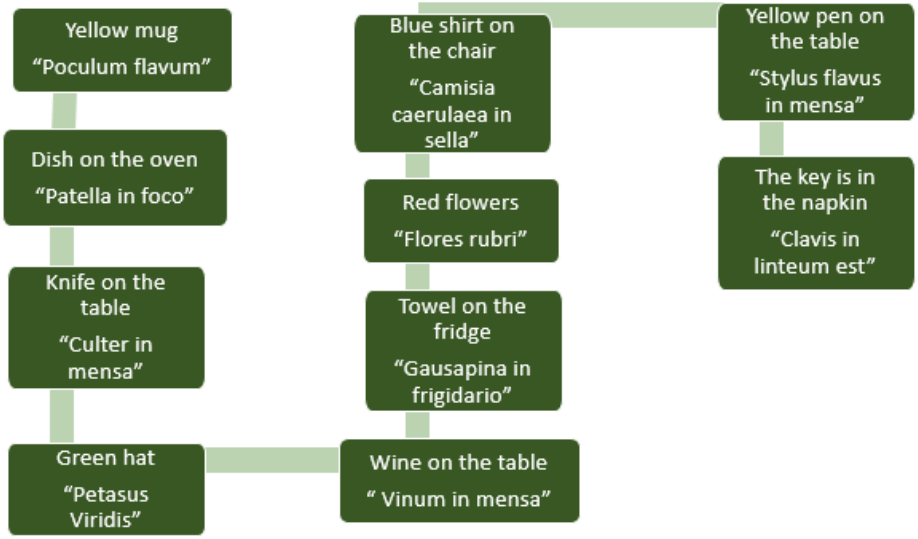



## B.2 Sequence of Messages displayed in each room

The 4 diagrams above present in a sequence the messages that each player will receive from the other 3 players. The messages received determine the sequence of the objects that should be clicked in the corresponding room by each player.

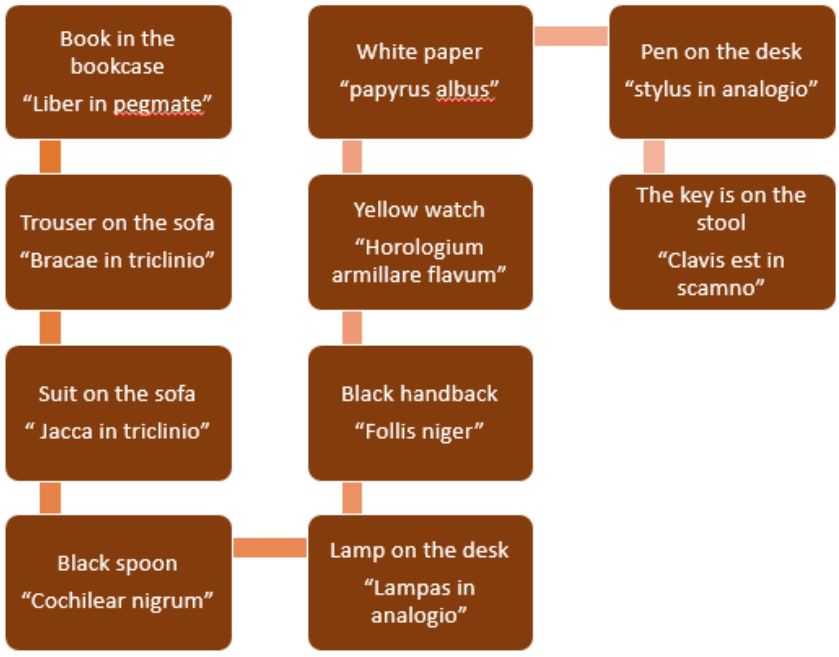
**KITCHEN**

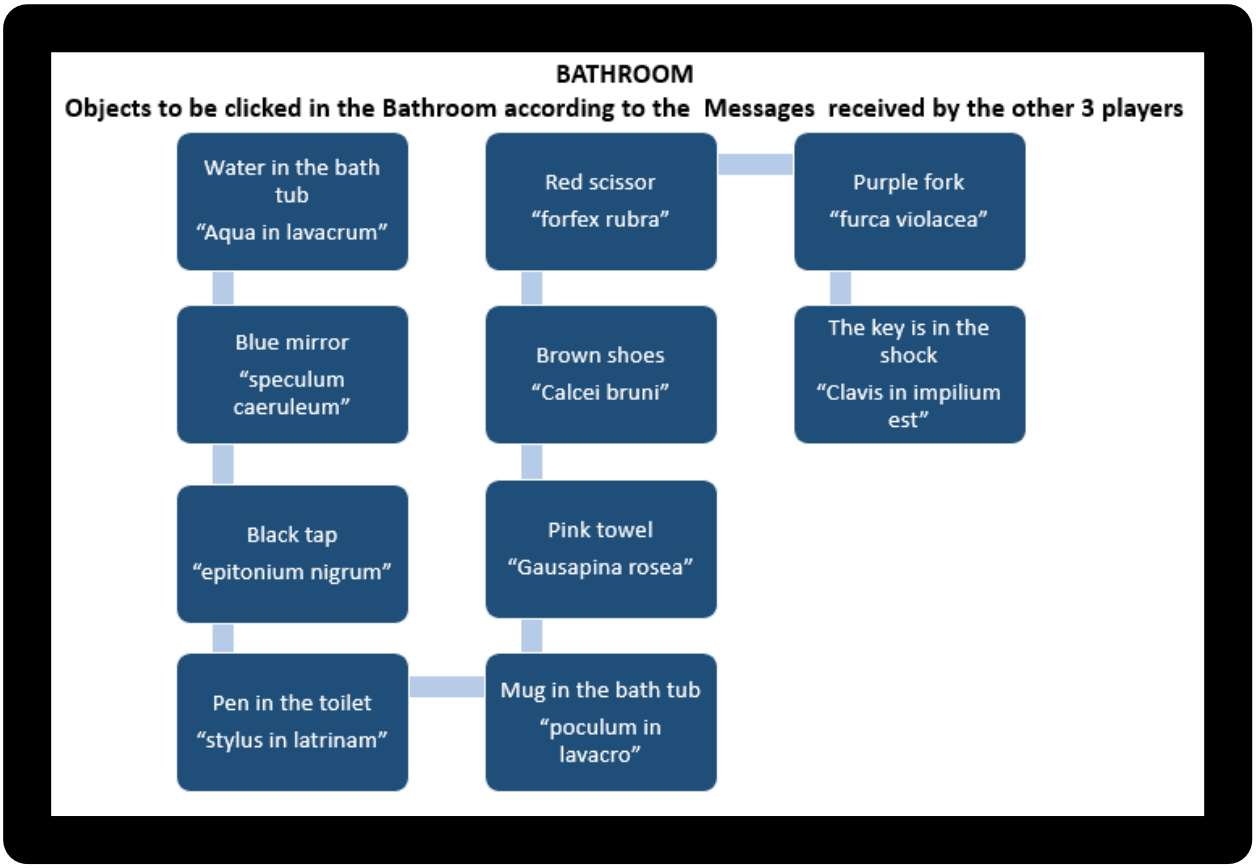
**Objects to be clicked in the Kitchen Room according to the Messages received by the other 3 players**

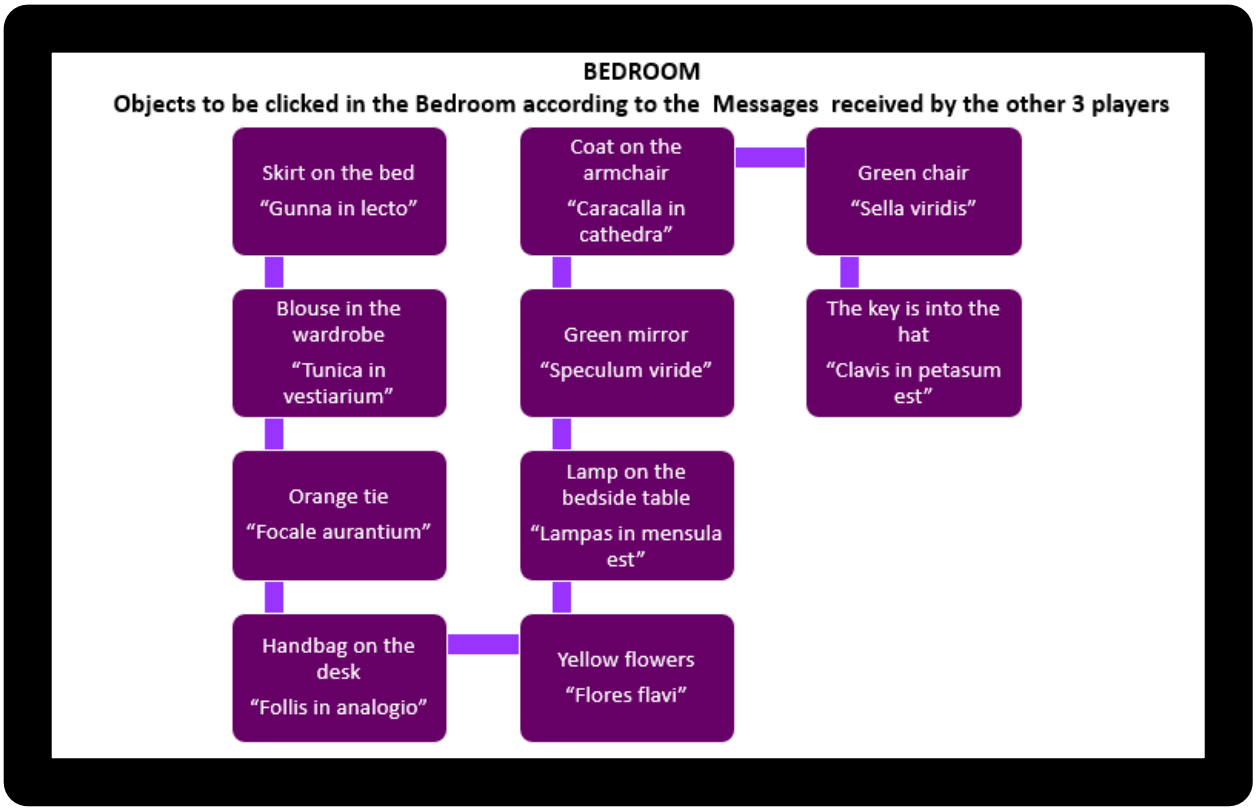



**LIVING ROOM**

**Objects to be clicked in the Living Room according to the Messages received by the other 3 players**




BATHROOM
Objects to be clicked in the Bathroom according to the Messages received by the other 3 players
Water in the bath tub
"Aqua in lavacrum"
Red scissor
"forfex rubra"
Purple fork
"furca violacea"
Blue mirror
"speculum caeruleum"
Brown shoes
"Calcei bruni"
The key is in the shock
"Clavis in impilium est"
Black tap
"epitonium nigrum"
Pink towel
"Gausapina rosea"
Pen in the toilet
"stylus in latrinam"
Mug in the bath tub
"poculum in lavacro"


BEDROOM
Objects to be clicked in the Bedroom according to the Messages received by the other 3 players
Skirt on the bed
"Gunna in lecto"
Coat on the armchair
"Caracalla in cathedra"
Green chair
"Sella viridis"
Blouse in the wardrobe
"Tunica in vestiarium"
Green mirror
"Speculum viride"
The key is into the hat
"Clavis in petasum est"
Orange tie
"Focale aurantium"
Lamp on the bedside table
"Lampas in mensula est"
Handbag on the desk
"Follis in analogio"
Yellow flowers
"Flores flavi"