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The use of 3D Multiuser Virtual Environments in Computer Assisted Second Language Learning: A Systematic Literature Review

Abstract

The rapid development of Information and Communication Technologies (ICTs) is influencing the way we learn. 3D MultiUser Virtual Environments (3D MUVE) is an emerging technology that is increasingly used in Computer Assisted Language Learning (CALL). Virtual environments are immersive, virtual worlds that could enhance second language learning (SLL). However, due to the novelty of the medium, the field lacks of a complete, systematic literature review that can support or reject the argument that "3D MUVE can enhance SLL". The aim of this paper is to map this emerging research field. For this purpose, a published method for conducting systematic literature reviews was employed. Using this method, we identified 128 relevant papers. From these, we selected 32 that included case study results and employed general purpose virtual worlds (e.g. Second Life) rather than games (e.g. Warcraft). The results suggest there is evidence of improvement in learning outcomes, communication skills and motivation. In addition, this paper sheds light on areas requiring further research, such as the instructor's role in a 3D MUVE.

Keywords: 3D MUVE, SLL, CALL, virtual worlds, 3D game, collaborative learning

1.Introduction

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 an important 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 and Ip 2009, 250)

It is interesting 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 principals 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 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).

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

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In marked contrast to a lack of motivation in school learning, students are engaging in multiliteracy activities outside of school spaces (Prensky 2005). Taking into account that, as noted by multiple researchers (Squire 2006), many youths 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. Concluding, the contribution of this paper lies 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.

This paper attempts 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.

The specific objectives of this research 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, present and assess popular practices for language learning applied in virtual worlds.
- To explore the potential of the virtual 3D environments and identify possible problematic areas.

This paper consists of five sections. The first one is the introductory section that gives the definition of the problem, the scope and objectives of the study and the structure of the paper. The second section presents in summary the potential benefits using virtual world in second language learning. In addition, it explores innovative practices used by universities, companies and communities of volunteers for second language learning in 3D virtual environments. The third section describes the methodology followed for the literature review. The methodology applied is adapted to the requirements of the topic. The fourth section presents the results of the literature review in tables. Key concepts such as the benefits and the problems identified in this type of learning are analyzed. The fifth and last section provides the conclusions of this work and suggests ideas for future enhancements.

2.Related Work

2.1. 3D MUVE benefits

The 3D multi user virtual environments (3D MUVE) appear to hold great potential for second language learning and especially for applying principals of constructivism. 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,
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2.2. Popular Practices for Second Language Learning in 3D MUVE

In order to explore the latest trend, we attempted to visit a variety of educational environments focused on language learning. The research uncovered that none of the educational projects, mentioned in published papers, could be found online. Thus, we retrieved information of the papers' descriptions. Additionally, we included in our research some online virtual environments (of profit and nonprofit character) found in the directories of the most popular 3D platforms, such as Second Life and OpenSim. The activities offered can be categorized as follows:

- **Role-Playing:** Several settings (e.g. cafe, bakery, super market, post office, bank etc.) are developed on the virtual environment. The students are supposed to perform different roles based on the teacher's instructions.
- **Virtual trips:** Virtual trips to several popular cities or to worldwide monuments or to museums are organized by the instructor in order to stimulate possible spontaneous conversational scenarios among the students or among the students and native speakers found in the virtual world.
- **Quizzes:** The virtual environment contains embedded quizzes designed to teach and practice mainly grammar concepts and vocabulary. The questions usually include audio, text and video. The student takes the quiz individually by interacting with the objects and the non-playing characters of the environment.
- **Games:**

  a) Games with Levels: Game levels are set with different degrees of difficulty in order to prepare the learner for the final and most challenging level. The first levels usually provide students with rich language input ranging from vocabulary, grammar, listening, reading, writing and test them through quizzes. (Gonzalez-Pardo and Camacho 2013) The final level can be a a quiz-like activity to be performed in teamwork, either by competing with other teams or by performing a role play task that demands collaboration.

  b) Board language games: The board language games are activities that are based on static boards. The students are placed into teams to play a game. It can be a modern or a traditional board game such as domino. To move their pieces forward they usually need to answer questions or to move objects of the environment.

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c) Maze games: The learner has to find the way out of the labyrinth by interacting with several objects and by answering quiz questions.

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 are not many designed language collaborative, multi-user games that make effective use of the 3D virtual space. Apart from the role-playing games, the activities that are multiuser 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.

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 focused on modelling and lack a pedagogical frame. Additionally, there is not always innovation. Similar activities such as the shopping task and the roleplaying 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.

Table 1 summarizes the basic characteristics of the aforementioned 3D virtual environments and the language activities that take place in 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. 3D virtual environments characteristics

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

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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

3.Methodology

In order to conduct the literature review we apply the Webster and Watsons' (2002) literature review approach. This 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.

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The relevant research papers are detected using specific keywords in a variety of scientific databases. We search different combinations of these keywords and phrases: "multi user virtual environments" and "MUVE", "second language learning", " foreign language learning" , " three dimension" 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 is also conducted in specific journals databases, such as ReCALL, which is the main publication of EUROCALL and 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 results in the identification of numerous relevant articles that are further reviewed. This leads to a sequential investigation of their references, which results in a second round of literature review and the collection of additional articles. The above searches result in 128 published articles in total. After reading the abstracts it is found that several of the articles are not within the specific field of knowledge and thus rejected while some other articles are not publicly accessible, thus they are not included in the present work.

The selection of the articles is based on a set of criteria. The articles selected are published in scientific journals or conference proceedings and are written in English language. Articles published before 2005 are rejected as we consider that the rapid evolution of technology makes them obsolete. Articles that do not include an experiment and results are 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 are rejected. Finally, 32 cases are 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 indicated in Table 2.

Table 2. 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 address the following questions:

- Are these environments used for blended or for synchronous learning?
- What it the most and what is the least explored topic?
- What is the teaching approach applied?
- Which tools and activities are most used?
- What is the instructor's role?
- What benefits and problems were encountered?
- What is the participants' profile?

4.Results

4.1. Overview of the cases and research profile

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Table 3 provides 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 3. Cases included in the literature review

Id	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

4.2. Research method applied

The majority of the researches apply a quantitative method and a few of them apply a quantitative and a qualitative method both. Table 4 presents the results.

Table 4. 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 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 following 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

4.2. Participants' profile

Table 5 presents data regarding the size of the sample of each research, the participants' age and mother tongue.

Table 5. 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

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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 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 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 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 takes place in universities.

In concerns to the native language of the participants, the most common languages are Chinese, English and Spanish. Some studies 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 3 and Table 5 we conclude that the most common participant's profile is a learner who is:

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

4.3. Learning type applied

The results are presented in Table 6. This table points 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 is 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.

Table 6. 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

4.4. Main focus area of the research

Table 7 presents the main focus areas of the research conducted in the 32 studies.

Table 7. Main focus area of the research

Focus of the Research	**Case**	**Sum**
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

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

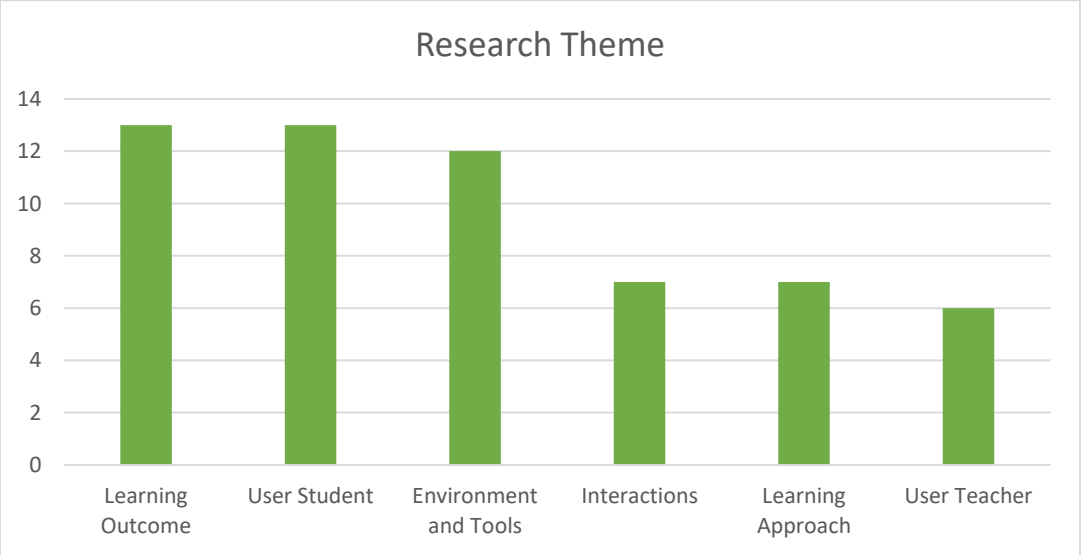

Figure 1. Research Theme

Most 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) and 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***.**

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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)

Seven 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*. Seven 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)

4.5. Learning approaches applied

The categorization of the papers is based on their authors' 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 principals 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

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. and Tracy D. 1983). The behaviorist view of learning emphasizes the repetitive conditioning of learner responses. Learning is an automatic process of "Stimulus-Response" association that is reinforced through rewards or punishments. Behaviorist 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 use their body to act out the words or phrases or sentences that the teachers said (Kan, et al., 2010). Behaviorist theory is usually related to the audiolingual/ audiovisual method, associated with the use of repetitive drills (Rosamond, Myles and Marsden 1998).

Based on these principles we evaluated and categorized the study cases (Table 8). The categories are cases that apply learning approaches which derive from the Social or Cognitive constructivism or from the Natural Approach or from the Behaviorism.

It was not a surprise that an overwhelming majority (78%) of the studies applied or attempted to apply the principals of social constructivism. The 3D MUVEs are environments that due to their

features can easily promote this approach. In 29 of 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 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 that emphasize on the comprehension of the input through listening and responding with gesture and sign language, deriving from Natural approach and other 3 that focus on the pronunciation and memorization through pattern drills and use of multiple media to convey information deriving from Behaviorism.

Table 8. Learning Approaches Applied

Language Acquisition	**Learning Approaches**	**Cases**	**Sum**
Social Constructivism - Vygotsky	Communicative Task based Game based Problem Solving Co-operative Situated Dialogical 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 Krasen and Terrell	Direct Method Comprehension Total Physical Response (TPR)	C4, C20	2

Behaviorism- Pavlov, Skinner	Drill based Audio lingual	C4, C5, C20	3

4.6. Tools used in the 3D environments

Table 9 lists specific tools and applications that are used in the 32 examined case studies, and the frequency with which each one is met. 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 32 cases use external applications such as YouTube, Moodle, wikis, email, Skype, Google documents digital dictionaries, and Facebook. As for 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.

Another finding is that educational tools such as electronic whiteboard or translation tools or notecards 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.

Table 9. 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

4.7. Activities in the 3D MUVE

Table 10 summarizes the activities that took place in the 3D MUVE. 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 where learners 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 have to compete or 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 these 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 32 cases. This is considered to be a pre-scheduled activity, usually individual and accompanied by multiple choice quizzes.

Teleporting occurs in 6 of 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.

Table 10. 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

4.8. The instructor's role

Table 11 summarizes the results regarding the instructor's role. In most cases the teacher acts as a moderator. The teacher offers help, organizes the tasks and facilitates the learning process without playing a leading role. In some cases, the teachers created the teaching material but only in one case 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. In addition, only in one case the teacher participated as a trainee. Finally, there are 3 cases that 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 students later in the classroom or never. There are also 7 cases that are not included in the table below, as they provide no information about the role of the teacher.

Table 11. 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

4.9. Benefits identified in the study cases

Table 12 presents the main benefits from employing 3D MUVE. The majority of the cases identified as a benefit the improvement of the students' performance. Among the 32 cases, 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 that learning in a 3D MUVE 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 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 2001). Finally, collaboration is increased through in-world social interactions and team working activities and autonomous learning is promoted since the teacher acts as a facilitator.

Table 12. 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

4.10. Problems identified in the use cases

Table 13 presents the main problems from employing 3D MUVE. 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. A common problem they face is the camera control.

Another identified problem is that the learning results are not satisfactory. For example, in some cases the vocabulary gained is considered to be poor and the environment distractive. As a result, the students overlook important information. Another observation is that the environment is insufficient for beginners. One more common referred 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. However, this is almost impossible in this teaching environment. (Kan et all, 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 3D MUVE environment is realistic and similar to conversations with real interlocutors, the more foreign language anxiety (FLA) they experience. This contradicts other research suggesting students experience less foreign language anxiety in the 3D MUVE (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).

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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).

Table 12. 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

5. Conclusions and future work

5.1. 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 objective of this paper is to map this new field. To this end, 32 research cases that used 3D MUVE environments for blended or distance synchronous learning are studied.

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 are observed during 3D MUVE's usage in the examined cases. The most important issues are 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.

Another observation 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 research tests 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 multiuser and collaborative capabilities of the platform are often detected. Furthermore, it seems that there is a bigger emphasis on modelling the objects and 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.

5.2. 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 participates 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 authentic games. Some future research questions include:

- 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?
- What is the most efficient learning approach for these environments?
- Can virtual worlds increase the interest for learning ancient languages?
- Is the usage of these environments appropriate and beneficial in the secondary education?

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