Research Trends of Language Learning in Virtual Reality from 2003 to 2012: A Content Analysis

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Abstract. This paper conducted a content analysis of studies in language learning in three dimensional multi-user virtual environments (MUVEs) that were published in four journals from 2003 to 2012. A total of 23 articles were cross-analyzed by categories including research topics, target languages, technology usage, and research methodology to identify some of the research issues and limitations in the research area. It was found that research in communication was the most explored topic in MUVEs, and the 3D virtual world tool Second Life was the most widely used in language learning. However, the list of research topics and studying languages were rather limited. Thus, there are definitely needed more studies to enrich the research area. We hope that this paper can involve more language researchers in 3D MUVEs to provide students input- and output-rich and immersive environment where learning can be appealing, meaningful, and fun.

Keywords: MUVEs, virtual reality, virtual worlds, content analysis, research trends

1   Introduction

Owing to the rapid advance and popularity of wireless communication and multimedia environments, virtual reality/world, so called multi-user virtual environments (MUVEs), has received considerable attention in the recent five years [4]. Virtual reality is generally defined as small representations of content area or domains designed to "bridge the gap between reality and abstract knowledge by the discovery method" [5] (p.72). In order to create such environments, the systems commonly are theme-based and comprise full integration of artificial intelligence products and a wide variety of social communication tools. Because of its unique combination of features, virtual reality has been quickly introduced for educational purposes to promote authentic and immersive learning environments.

Virtual reality tools in nowadays are a far cry from the early two-dimensional (2D) text-based online virtual reality, such as multi-user domains (MUDs) and MUD-object oriented (MOOs), to which multiple users can be connected at the same time. Current virtual reality environments evolve more sophisticated interactive systems and a high degree of visual appeal, such as massively multiplayer online role-playing game (MMORPGs), to allow a wide range of interlocutors to communicate, cooperate, and compete through their customized three-dimensional (3D) virtual spaces and avatars (called residents). Furthermore, virtual reality utilized in computer-assisted language learning (CALL) area usually provides multiple communication channels (i.e., instant messaging and voice chat) and data-recording features, to which additional sources of input, output, and feedback can be offered for language learners. Accordingly, several evidences have proved that such virtual

learning environments can effectively increase learning involvement and motivation [8] [17], reduce learner anxiety [9], support the development of learner autonomy [10], and promote interactive and creative ways of teaching and learning [7].

Comparing to other Web 2.0 tools, however, virtual worlds have been less frequently explored [2] [15]. As a consequence of this, virtual reality in language learning has been claimed to be the least published research topic in the CALL area [4], and thus what virtual reality (or virtual world) actually means today remains controversial. Thus, the purpose of this study is to conduct a content analytic approach systematically to review and synthesize the literature of language learning in virtual reality from 2003 to 2012 (ten years). Reviewing the research trend of MUVEs may help practitioners, educators, and researchers identify research interests and gaps, and further provide them with a reference to make plans in the future. For the research purpose, this leads us to ask questions such as, "How important is MUVEs in learning languages?", "Are there particular software which can better meet the needs of certain types of language programs?", and "Is there a reason why virtual reality is claimed to be the least published research topic in the CALL area?" In order to answer these questions, the four "best" English language journals in the field of CALL were examined, including *Language Learning & Technology (LLT), CALICO Journal, Computer Assisted Language Learning (CALL),* and *ReCALL* [12]. This study further extends the previous studies' frameworks to analyze virtual reality research trends according to four categories, namely the research topics, the used technology programs, the target languages, and the research methodology [4][13]. Four research questions addressed by this paper include:

1. What topics related to language learning in virtual reality were published in these journals from 2003 to 2012?
2. Which languages have been targeted to study language via virtual reality tools?
3. What technologies have been used in the studies on virtual reality?
4. What methodology (i.e., research types, methods, and sample groups) were applied in the studies on virtual reality from 2003 to 2012?

2   Methodology

To find studies for the content analysis, computer searches of journal databases were carried out. Top four CALL-specific and education technology-related journals [12] were selected, including *Language Learning & Technology (LLT)*, *CALICO Journal, Computer Assisted Language Learning (CALL),* and *ReCALL.* There were a total of 1160 documents published by these four journals from 2003 to 2012. For the purpose of this study, the analysis included journal articles that went through a process of peer review, but columns, commentaries, editorial materials, and letters were excluded. After further comprehensive reviews through three researchers, a total of 41 document items from 2003 to 2012 were located through the researchers with the keywords as follows: simulation, virtual reality, 3D social virtual worlds (SVWs), 3D MUVEs, MOOs, MUDs, virtual learning environments, and MMORPGs. After coding the data, only 23 articles were considered as MUVEs (see Figure 1 for the distribution of articles over time). These articles have to fit the definitions of MUVEs as follows: (1) A shared space which is multi-user domain, (2) Persistence of the in-world environment, (3) Aim for bringing simulated real life experiences, such as topography, movement, and physics that offer the illusion of being there, and (4) Optional: Non-player characters (NPCs), data-recording features, 2D, or 3D [11].
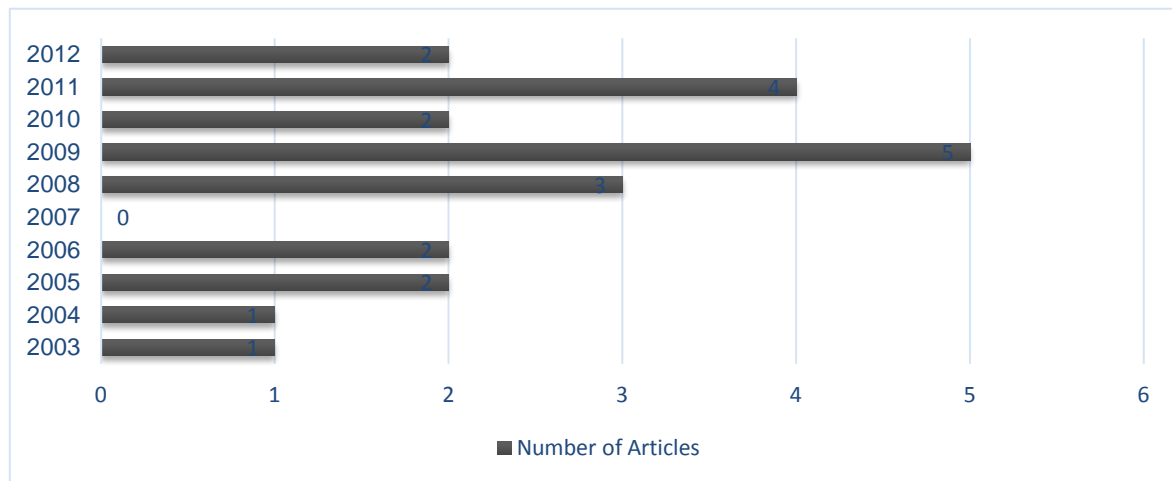
2012 — 2
2011 — 4
2010 — 2
2009 — 5
2008 — 3
2007 — 0
2006 — 2
2005 — 2
2004 — 1
2003 — 1

0 1 2 3 4 5 6

■ Number of Articles

Fig. 1. Distribution of Articles over Time

2.1 Selection of research topics, languages and technologies

One of the major purposes of this paper was to indicate research topics in MUVEs from 2003-2012. All articles were categorizing according to focus of target topics, technologies, and target learning languages.

2.2 Choice of research types, methodological approaches and sample groups

After the three researchers' discussion and consensus, three categories of research types were identified: research article and review article. The methodological approaches were identified, including quantitative research

approach, qualitative research approach, and mixed-method approach. Seven categories modified from Hue et al.'s (2012) study were utilized to identify the research sample groups as follows: 1. Elementary school, 2. Junior and Senior high school, 3. Higher education, 4. Pre-service or in-service teacher training program, 5. Adults, 6. Others, and 7. Non-specified.

2.3 Data Coding and Analysis

This study used all of the articles relevant to virtual reality published in *LLT*, *CALICO, CALL,* and *ReCALL* from 2003 to 2012 to investigate the research trends. Since "content analysis is a summarizing, quantitative analysis of messages that relies on the scientific method" [6] (p.10), descriptive statistics was utilized to categorize the research topics, technology usage, target languages, sample groups, research types, and methodological approaches. It is important to note that some of the category analysis would not include the review papers, such as sample groups, target learning languages, and technology used for virtual reality since this type of articles did not provide empirical evidences.

To obtain more reliable outcomes from coding, three researchers (a professor, a post-doctoral researcher, and one assistant researcher) in educational technology helped to code these studies based on the aforementioned categories. Their number of years of language teaching experience ranged from five to 15 years. All three researchers knew more than one foreign language (e.g., Spanish, Chinese, English, and Italian) and had taught online courses in more than two different countries before. The coding process was carried out manually by the researchers. Ten articles were randomly selected and followed the same coding process. The results were

compared using Pearson correlation coefficient measures of reliability, yielding a reliability of figure of $r = .88$. After the initial coding process, a descriptive analysis was conducted to report the data.

3　Results and Discussion

3.1　Research Topics

There were 16 target topics found in the aforementioned 23 articles. These topics can be further grouped in broader categories: learning behavior, attitude, and perception (i.e., learner engagement, self-efficacy, motivation, oral participation, and learner autonomy), communication skills (i.e., interaction, argumentation and critical thinking, negotiation of meaning, and vocabulary knowledge), instructional design (i.e., task design), type of online language course delivery (i.e., online tandem language learning), and review of the literature in general.

In particular, student communication skills have received considerable attention due to the special nature of its virtual reality (i.e., providing multiple communication channels and allowing multiple social interaction) (11/23). However, most of these studies seemed to sole utilize one medium, usually text-chat function, which "can restrict the development of cooperative interpersonal relationships necessary for effective communication" [8] (p. 70). Some studies have remained largely exploratory in learner behavior, perception and emotional investment in the learning environments (5/23). It deserves to be mentioned that these articles consistently agreed that virtual reality learning environments promoted positive attitudes and enhanced learner engagement and motivation. However, a number of negative attitudes and potential problems were mentioned from both client-side and server-side issues. For user-related issues, for example, novice Second Life users seemed to consistently suffer from problems with complicated interfaces and hardware requirements (e.g., good graphic cards and high-speed Internet connection) [8]. Server-side issues included down time, frequent updates, lag, etc. These barriers seemed to be the reasons to hinder educators and teachers to implement the relevant tools in their classrooms. It was suggested that user-related issues can be solved through the long-term training [2] and financial support from the institutes or government.

Furthermore, two studies emphasized on task design both selected pre-service teachers as their major participants to gain a better understanding of how to effectively utilize the strength of virtual reality and then integrate pedagogical activities into the environments. These articles have provided us with knowledge from teacher's perspectives of how to foster student creativity and design authentic learning conditions in MUVEs. Unfortunately, these articles represented only a small portion of articles among all the selected articles. This finding reflects that little has known from empirical research about teachers' perspectives and decision making in MUVEs. The gap existing between students' and teachers' perspectives to be engaged in these environments have yet to be studied and illustrated. Meanwhile, four studies from 2003 to 2006 seemed eager to implement virtual reality tools to promote bilingual tandem language exchanges. Surprisingly, this type of language learning format did not receive much attention after 2006. Due to these evidences, there is a need to focus more on any creative task design and innovative language teaching formats in such environments (e.g., role-playing, information gap, and jigsaw), so teachers and practitioners will have better understanding of how to implement virtual reality in their classrooms. Also, a broader range of topics are needed to explore, such as personal identity and behaviors of avatars in-world, the development of non-verbal communication (i.e., physical

gestures, poses, and animations), isolating experience in such environments, etc. Consequently, the research development of the virtual reality in language learning can be increased.

3.2 Technology Used for Language Learning

Through the selected empirical studies, Second Life (N=7, 37%) were the most used virtual reality technology for language learning. The second and third most used technology was text-based MOO (N=4, 21%) tools and Active World (N=3, 16%). Other technologies also included Quest Atlantis, The SIMs, Sim Theme Park, Utility, and Autodesk 3ds MAX (formerly called 3D Studio Max). It is important to note here that three quarters of the studies using MOO as the language learning platform was published before 2006. This findings indicate that text-based virtual reality can no more satisfy practitioner' needs. Rather, 3D virtual reality tools with the feature of multiple communication channels, such as Second Life and Active Worlds, might better suited for teachers' needs to create more interactive and collaborative tasks and thus to provide multiple ways of input, output, and feedback [8]. Since Second Life and Active Worlds were mostly used among the selected studies, we can also imply that these two platforms might more popular and mature tools dedicated in language learning [16]. Among the selected studies, we also found that five of them combined virtual reality tools with other asynchronous technologies in their studies, such blog, e-mail, Microsoft Power Point, Moodle, etc. to balance the disadvantages and advantages of both asynchronous (i.e., allowing students more time to reflect on the class materials and to organize their thoughts) and synchronous technologies (i.e., promoting real-time activities).

3.3 Target Learning Languages

According to the result, most empirical studies emphasized on English (15 articles) as a foreign language, a second language, a lingua franca, a bilingual tandem language learning, or for special purposes. Obviously, English learning has been widely implemented in different purposes and types of language teaching comparing to other languages. The next most frequently target languages in the selected studies were German and Spanish, found in four and three respectfully. It is important to note that three studies involved teaching two languages particularly in these enhancing tandem language learning based on mutual language exchange between partners who are native speakers of the target languages. The finding indicates that none of the East Asian languages (e.g., Mandarin Chinese, Japanese, and Korean) and Arabic languages, and only few languages of Europe, were investigated in virtual reality learning environments. This implies the pioneer stage of virtual reality in language learning research. As researchers, we definitely need more inquiry into this research area by involving diverse learner groups within various methods of language teaching.

3.4 Target Sample Groups

As seen in Figure 2, Out of 23 studies selected for this paper, 11 articles involved language learners in higher education. The same number of studies followed in junior and senior high schools (N=3), and in pre- and in-service teacher training programs (N=3). Only one involved language learners in an elementary school, and none of the studies were focused on adults and others. Five articles were not specified since all of these articles were identified as review papers. It is worth to be mentioned that K-12 settings were using the software, such as Autodesk 3ds MAX or Quest Atlantics, rather than Second Life (even though Second Life was rated as the most
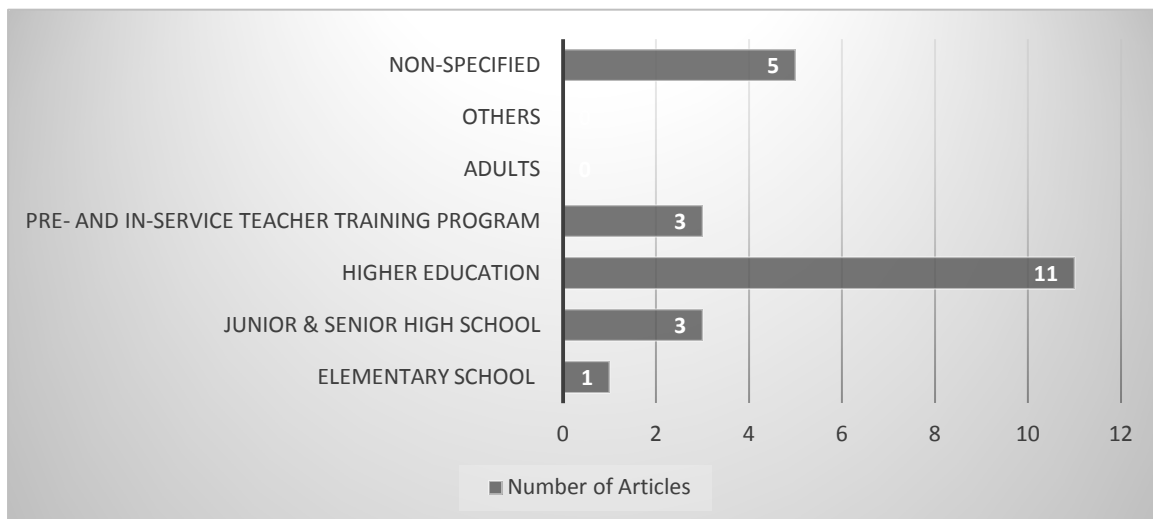
Fig. 2. Distribution of Sample Group Selections from 2003-2012

used technology in the previous section). As most researchers will agree, Second Life contains complicated interfaces [8] and requires frequent updates [3]. Since it is an open source with various kinds of features and virtual spaces, instructors does not much control over who will communicate with their students outside of class time, what locations they will visit in the virtual environments, etc. Safety remains concern for using such software in education settings. To solve the barriers, Second Life has divided its regions into general, moderate, and adult regions to avoid residents under 18 receiving adult content. Additionally, several software were developed and advocate its educational objectives by carefully incorporating pedagogy into the immersive spaces (e.g., Active World Educational Universe, Croquelandia and Zon) [14].

3.5 Research Types and Methodological Approaches

The research types were distinguished research articles (N=19, 78%) and review articles (N=5, 22%). Among the research articles, most of them conducted qualitative research (N=12, 52%) which involve case study, discourse analysis, and action research approaches through the analysis of chat recordings, field notes, interviews, participant self-refection reports, essays, floor spaces, turn lengths, turn taking patterns, etc. The same number of studies followed quantitative research (N=3, 13%) and mixed-methods (N=3, 13%). While quantitative research involved objective measurement and statistical analysis to answer the research questions, mixed-methods applied both qualitative and quantitative research approaches. Although these articles conducted different research approaches, authors consistently advocated that MUVEs as promising arenas for language learners by offering significant opportunities for engaged student-centered collaborative and social interaction, for the development of engaging tasks (i.e., increasing motivation, self-efficacy and autonomy, and reducing student anxiety), and then enhancing learners' communicative skills [1] [8] [7] [14]. Furthermore, pedagogical implementation and technical problems seemed to mention throughout most of the articles.

4 Conclusion and Future Prospects

These selected studies definitely shed light on what educators can do to make their language teaching virtual reality more effective. However, there are several issues needed to be further explored. The analysis of the topics of the selected articles showed that these articles primarily emphasized on learner's learning behavior, attitude

and perception, and their communication skills. Due to the result, a broader range of research topics are needed, such as task design, student personal identity, the usage of the non-verbal communication tools in MUVEs, etc. We also found that English, German, and Spanish were most frequently researched; however, the list of the languages were rather limited. In the analysis of group samples, only three out of the 23 articles were conducted with K-12 language learners; and two out of these selected articles were conducted with pre-service teachers while others emphasized on under-graduated language learners. We consider such a lack of virtual reality studies on a wide variety of languages and research sample groups as major gaps in the research literature. Finally, technical problems (i.e., possessing a current state-of-art computer system, having a high speed Internet connection, etc.) seemed to be one of the concerned issues while implementing virtual reality in language learning. Thus, we suggest that with a through consideration of software affordances and constraints, a long-term technical training, and financial support from the institutes and government can be effective in order to solve these issues.

This study is not without limitation. Three main points arise are that only four English language journals in the CALL field were investigated, which excludes good work in other languages and relevant publications. It is suggested that future research should conduct similar studies with more research data to develop more deliberate analysis.

Acknowledgement

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