A PROPOSAL FOR A VIRTUAL REALITY METHOD IN LANGUAGE LEARNING

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Abstract

The paper presents a new method for the use of extended reality (XR) technologies in education, particularly in language learning. The authors realized a prototype of XR environment for distance learning of French language, via the software Unreal Engine 4. It deploys two types of VR activities, with the aim to improve understanding of grammatical concepts and memorization of new words, respectively. The dimension of depth is embedded into the learning process, by exploiting the kinesthetic aspects of the immersive environment. Thus, the learner moves in space and manipulates specific virtual objects involved in the learning activity to complete the task. A qualitative assessment has been conducted with a limited number of target students and now is currently under a wider experimental validation. However, the article introduces also the theoretical aspects of the new method, paving the way for further development.

Keywords: Extended reality, multimedia learning, language learning, MOOCs, kinesthetic mental model.

1 INTRODUCTION

The advancement of immersive Extended Reality (XR) technologies has enabled their implementation in various domains, including education. In the field of language learning, VR has been the focus of several studies, where the immersive experience often replicates everyday scenarios where individuals need to communicate in a foreign language to be understood [1]–[5]. As could be expected [6], there is a growing convergence in education between immersive technologies and the MOOC methodology, opening up opportunities for MOOC courses that provide immersive content through VR (Virtual Reality). In April 2022, Coursera, which is presently the largest MOOC platform globally with over 118 million users [7], made an announcement that it would collaborate with the University of Michigan to deliver ten courses enhanced with XR technology [8]. Currently, Coursera offers several online courses with VR experiences incorporated. Starting from April 2023, Coursera's language learning course "Chinese for Beginners" is also including a few VR experiences. From the analysis of the cited studies, it emerges that language learning has yet to adopt a targeted approach aimed at the systematization of an instructional design method making use of VR, unlike what happened in the e-learning field with the innovations brought by the MOOC approach in recent years.

2 METHODOLOGY

The authors developed a model of an XR setting for language learning using the Unreal Engine 4 platform. The prototype comprises two types of VR activities to facilitate distance learning of French language. The objective of the first type of VR activity is to enhance the comprehension of grammatical concepts, whereas the second type is aimed to foster the retention of newly learned words. The proposed model is based on Richard Mayer's Cognitive Theory of Multimedia Learning [9] and studies on the kinesthetic aspects of language learning.

The *multimedia principle*, developed by Mayer, emphasizes that "people learn better from words and pictures than from words alone", because they can construct verbal and visual mental models and establish connections between them. In two-dimensional media, like book pages or a computer screen, the written or spoken word is perceived through the verbal channel, while images, with their height and width, are perceived through the visual channel.

Over time, several authors have explored the relationship between body motion and second language learning [10]–[13]. One of the most influential studies is Asher's Total Physical Response (TPR) [10]. This approach involves the teacher giving commands that prompt the students to perform actions, thus creating associations between words and physical movements that foster learning. With the advent of video game consoles and virtual reality headsets, the research on kinesthetic language learning has increasingly incorporated these recent technologies. A couple of interesting studies are those of Edge

et al. [14], who realized a Kinect game that utilizes TPR principles for language learning in the absence of a human teacher, and Vázquez *et al.* [15], who developed a kinesthetic VR system to learn Spanish vocabulary through the linking of words with body movements performed in an immersive environment, perceived via the HTC Vive VR headset.

The authors developed a prototype of XR setting that uses depth to activate kinesthesia in learners. By exploring the scene, learners use their bodies to move in space and manipulate virtual objects that are part of the learning activity and have a specific position in the virtual learning environment. Thus, in a three-dimensional medium that exploits depth to foster learning, it can be hypothesized that learners use a third channel to acquire significant information, in addition to the verbal channel and the visual channel. The third channel originates in the body movements towards the virtual objects and can be named as *kinesthetic channel*. It allows learners to acquire an additional type of information, designated as *spatial information*, which concerns the position of the virtual objects that are part of the learning activity within the scene. In the brain, spatial information integrates with verbal and visual information, improving the quality of the learning process. Consequently, in a 3D learning environment that incorporates depth into the learning process, the multimedia principle can be redefined as *augmented multimedia principle*: “People learn better from words, images and the position of bodies in three-dimensional space than from words and images alone”, because they can construct verbal, visual and kinesthetic mental models, establishing connections between them.

3 RESULTS

The augmented multimedia principle was applied to two types of VR activities, which are suitable for integration into a French language MOOC course. These activities are meant to be experienced using the Meta Quest 2 VR headset. Both activities are set in a zen-style villa, asset freely available in the Unreal Engine marketplace. The "Comprehension" activity is aimed at improving understanding of grammatical concepts, whereas the "Memorization" activity is focused on promoting memorization of new vocabulary words.

3.1 Comprehension VR activity

In this activity, the user is presented with four boxes, each labeled with one or more words. A text widget embedded in the scene provides instructions on how to complete the activity (Fig.1). The learner is required to construct a sentence in French, by moving the boxes onto the empty shelves of a shelf (Fig.2). The goal of the activity is to learn how declarative sentences work. This type of sentence makes a statement on a fact, an opinion, a thought, etc. and contains at least a subject, a verb, and an object, which must maintain this word order [16]. If the sentence includes both a direct object and an indirect object, the direct object usually precedes the indirect object. The selected sentence for this VR activity is "Hervé explique son problème à Julie." In this sentence, "son problème" is the direct object, whereas "à Julie" is the indirect object. The boxes contain the following words:

box 1: Hervé

box 2: explique

box 3: son problème

box 4: à Julie

While boxes 1 and 2 are quite intuitive to place on the shelf, boxes 3 and 4 are more challenging, because the sentence "Hervé explique à Julie son problème" - even though incorrect - still makes logical sense. This is a problem of word *positioning* in the sentence, therefore bringing the sentence into the three-dimensional space of VR and using body movements (kinesthetic channel activation) to place the words/boxes correctly on the shelf (spatial information acquisition) should enhance the learner's comprehension of the grammatical rule.

Once the sentence is complete, the learner can check their answer by pressing the B button on the controller. If the answer is incorrect, the boxes will jump off the shelf and fall to the ground, requiring the user to pick them up and try again to correctly position them on the shelf. Pressing the B button when the boxes are correctly positioned will cause the system to speak the sentence, confirming to the learner that their answer is correct (Fig.3).

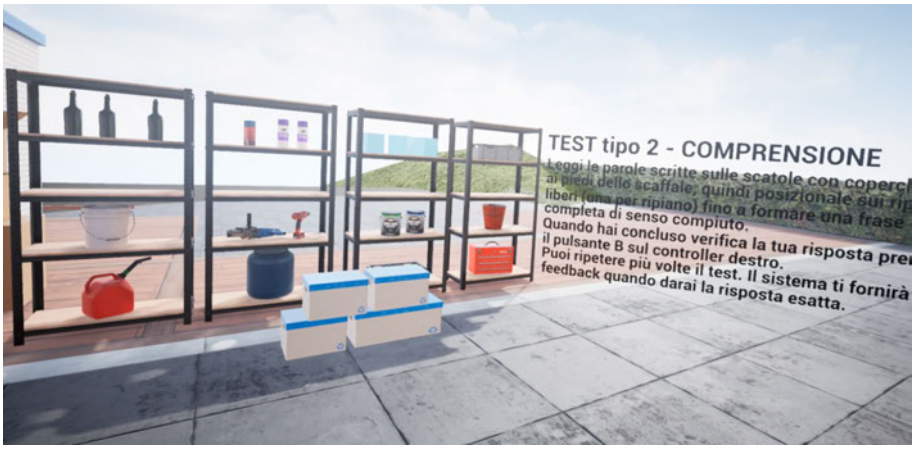

Figure 1. Initial state of the comprehension activity.

Figure 2. Boxes positioning.

Figure 3. Sentence completion on the shelf.

Research evidence shows that providing video feedback on self-assessment test responses enhances and accelerates the understanding of the content covered, leading to better performance on a subsequent test on the same topic [17]. To take advantage of the positive impact of feedback on learning, in this activity the learner presses the B button again after listening to the correct answer, to display a widget containing textual feedback that explains the grammar of the sentence (Fig.4). The use of feedback is essential to clarify any doubts that the learner may have about the use of the grammatical rule necessary to form the sentence correctly.

Figure 4. Grammatical feedback.

3.2 Memorization VR activity

The activity of memorization of new words takes place inside a furnished room in the villa, and also in this case a textual widget provides instructions for the learner in order to complete the task. The goal is to learn the names of some furniture items in French. The names of the furniture are written on eight plates on the table in the center of the room (Fig.5). The user must pick up each plate, move around the room while holding the tag (using the controller), and then attach it to the correct piece of furniture (Fig.6). In this case, the kinesthetic channel is activated by moving in the room and using muscles to attach the plate to the furniture, whose position inside the room is registered by the brain as spatial information. If the plate is incorrect, it won't attach to the furniture. Conversely, when the plate is correct, it will attach to the furniture, and the system will pronounce the name of the furniture in French.

Figure 4. Room and table with plates to attach.

Figure 4. Attaching plates to furniture.

To carry out an initial impact assessment and evaluate potential visual discomfort of both VR activities, the implementation was tested and validated by a small panel of 4 teachers (2 males and 2 females) from various technological and linguistic disciplines. Subsequently, a few tests were conducted with 4 female students from the master's degree course in Digital Humanities at the University of Genova. The qualitative feedback was very positive. Based on this, various adjustments were made and the experiment currently being carried out with a group of about 30 students has the objective to assess the impact on learning.

4 CONCLUSIONS

The prototype of XR setting incorporates two types of activities that are well-suited for inclusion in MOOC courses that offer VR content, owing to activities' objectives and their short duration. These activities are complementary to VR dialogue simulations that are currently widespread, thus they can all coexist within an online course, providing diversified benefits to students' learning. The theoretical and practical foundations have been established for an approach to VR in learning that take advantage of the dimension of depth by bringing it into the learning process. This led to an update of Mayer's multimedia principle that takes into account the influence of the kinesthetic aspect on the perception of the position of the virtual objects that are part of a learning activity. The activities were designed to engage visual channel, verbal channel (both written and spoken word) and kinesthetic channel in the learning process. The tests performed so far have shown a good appreciation by the students and an experiment is underway to investigate the effects of this new approach on students' learning performance.

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