Why virtual, why environments? Implementing virtual reality concepts in computer-assisted language learning

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The research area of computer-assisted language learning (CALL) has recently shifted from seeing the computer as a tool or partner to seeing it as a virtual environment where learners can collaborate and interact with a wide variety of native speakers. In addition, CALL has also increasingly benefited from the theoretical framework of learner autonomy, although it has frequently been misunderstood as self-directed learning. In light of these developments, terms such as virtual *and* environment *need to be defined. So far, the large tradition of virtual reality (VR) research and its concepts has largely been neglected in CALL and second language acquisition (SLA) research. However, a critical and reflective analysis of VR tools and their underlying concepts shows that learner autonomy and VR are in fact an ideal combination for language learning: first, by raising language and linguistic awareness; second, by supporting interaction and collaboration with peers and native speakers; and third, by providing an experimental, learner-centered learning environment. The article concludes with a summary of design principles for CALL software.*

KEYWORDS: *CALL; constructivism; human-computer interaction; instructional design; learner autonomy; MOO; NLP; presence; situated learning; tandem learning; virtual reality; Vygotsky.*

The past few years have seen important shifts within the area of computer-assisted language learning (CALL). From a theoretical perspective, we have seen that learner autonomy has become a prominent framework for new CALL research and development. We would like to emphasize that we do not understand learner autonomy as simply self-directed or self-access learning but as a concept that strives to support language and linguistic awareness through interaction, collaboration, and critical reflection. In addition, we can see that more and more empirical research in CALL has focused on using the Internet not only as a vast information resource but as a system that can provide a multitude of communication tools to connect learners in more authentic ways than the real classroom to the target language community and its speakers. This focus is particularly valuable for foreign language contexts, as language learners do not have the same options for interaction with native speakers.

Within the concept of learner autonomy, we will here focus on three different strands: a more individual-cognitive view of learning as suggested in Kelly's personal construct theory, a social-interactive view of learning as proposed by Vygotsky, and an experiential and experimental approach to learning that has been developed in theories such as situated learning, constructivism and constructionism, and experiential

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learning. Particularly the last two approaches to learning have benefited greatly from research in computer-mediated communication (CMC).

From a CALL perspective, more and more empirical work has focused on CALL environments rather than isolated computer tools. In many current CALL publications, the term *environment* has often been combined with the term *virtual*. Although the next logical step would seem to be the implementation of an already established framework of virtual reality (VR) into CALL, this has only happened in part, no doubt influenced by the perceived technical requirements of VR and the psychological hesitancy of many educators. This neglects the fact that many low-level VR tools require neither highly expensive nor technically advanced equipment.

This article argues that VR concepts and its research share similar concerns and approaches with learner autonomy. The introduction of VR concepts into CALL programs can support learners in becoming more autonomous language users who can select and organize their own learning resources. Also, more autonomous language learners, who are able to plan, monitor, and evaluate their own learning process, will become more aware of the linguistic structures of their target language and their own learning process through the filter of a virtual identity.

Learner autonomy: Three perspectives and a learning framework

Learner autonomy has often been misinterpreted as either simply self-directed learning, a new method, or a new approach. However, the concept of learner autonomy recognizes that many learners do not possess the ability to plan, monitor, and evaluate their own learning process, and that they need support in the form of peers (e.g., in group- or project-based work), resources (authentic target language input), awareness-raising tools (e.g., diaries, posters), and the teacher (e.g., to discuss learning strategies). According to Little (1991),

> Autonomy is a *capacity*—for detachment, critical reflection, decision-making, and independent action. It presupposes, but also entails, that the learner will develop a particular kind of psychological relation to the process and content of his learning. The capacity for autonomy will be displayed both in the way the learner learns and in the way he or she transfers what has been learned to wider contexts. (p. 4)

Little (1996) presented Legenhausen and Wolff's model of language learning as language use (see also Eck, Legenhausen, & Wolff, 1994). In this model, the learner is at once

> 1. communicator—continually using and gradually developing communicative skills; 2. experimenter/researcher—gradually developing an explicit analytical knowledge of the target language system and some of the socio-cultural constraints that shape its use; and 3. intentional learner—developing an explicit awareness of both affective and metacognitive aspects of learning. (Little, 1996, p. 203)

Legenhausen and Wolff's model reflects three important strands in learner autonomy: supporting affective, linguistic, and cognitive awareness in learners (a more individual-cognitive view); using the target language in authentic contexts of interaction (a more social-interactive view); and creating and using environments where the learner can experiment with authentic target language resources and a variety of tools to make explicit underlying linguistic structures and intercultural dependencies (an experimental or constructivist view of learning).

The first, more individual-cognitive, perspective goes back to Kelly's (1963) theory of personal constructs. At its core, it promotes the idea of constructive alternativism, which means that humans build construct systems through which they view the world. These construct systems are always measured against their predictive efficiency. The theory of personal constructs thus suggests that "a person's processes are psychologically channelized by the ways in which he anticipates events" (Kelly, 1963, p. 46). These personal constructs need to be laid open, and learners need to become aware of them. In many situations, changes to construct systems may be difficult and even painful but are an important step for learners to be able to plan, monitor, and evaluate their own language learning process.

The second, more social-interactive, view of learning has been influenced by Vygotsky's (1978) notion of the "zone of proximal development. It is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). The influence of social interaction on learning is also recognized by Kelly (1963, p. 90), as his commonality corollary emphasized not only interpersonal relations but also the importance of other people for reflection and self-awareness. By anticipating the other person's reaction, we also anticipate the other person's reaction to our own behavior, and this could be continued ad infinitum. This social-interactive component is therefore also important for processes of self-awareness and reflection.

The third, experiential and experimental, view of learning is mostly influenced by Bruner (1986). It is in many ways a logical consequence of Kelly's (1963) and Vygotsky's (1978) approaches to learning. Although Bruner acknowledged the importance of "discovery learning" that he interpreted as "learning by inventing," he also emphasized the interactional dimension of learning:

> It is not just that the child must make his knowledge his own, but that he must make it his own in a community of those who share his sense of belonging to a culture. It is this that leads me to emphasize not only discovery and invention but the importance of negotiating and sharing—in a word, of joint culture creating as an object of schooling and as an appropriate step en route to becoming a member of the adult society in which one lives out one's life. (p. 127)

Wells (1987) formulated the experimental nature of learning, in that

> learning involves an *active* reconstruction of the knowledge or skill that is presented, on the basis of the learner's existing internal model of the world. The process is therefore

> essentially *interactional* in nature, both within the learner and between the learner and the teacher, and calls for the negotiation of meaning, not its unidirectional transmission. (p. 118)

The experimental element is also mentioned by Kelly. In his discussion of favorable elements for construct development, he suggested the existence of a laboratory-like environment with new materials (Kelly, 1963, pp. 161-162), in which new constructs can be tried on for size.

The notion of experimentation has been a prominent feature of instructional design theories in recent years. The idea of constructivism

> posits that (a) learners do not receive bits of knowledge and store them in their heads, but rather they take in information from the world and then construct their own view of that knowledge domain, and (b) that all knowledge is stored and accessed by an individual via experiences associated with knowledge in a particular domain. (A. A. Carr, Jonassen, Litzinger, & Marra, 1998, p. 8)

Papert's (1991) constructionism took the idea further:

> We understand "constructionism" as including, but going beyond, what Piaget would call "constructivism." The word with *v* expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the *n* expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable . . . a sand castle, a machine, a computer program, a book. This leads us to a model of using a cycle of internalization of what is outside, then externalization of what is inside. (p. 3)

This last sentence is reminiscent of Vygotsky's (1986) interpretation of Piaget's law of shift or displacement: "To become conscious of a mental operation means to transfer it from the plane of action to that of language, i.e. to recreate it in the imagination so that it can be expressed in words" (p. 163).

The notion of situated learning has also played a major role in instructional design theory:

> Situated learning theorists hold several beliefs about learning and knowledge building. The following assumptions are central to the arguments they make. Knowledge is a product of activity, not a process of acquisition. . . . Learning is a process of enculturation in a community of practice. . . . Learning is developing an identity as a member of a community of practice. . . . Meaning is socially constructed through negotiations. . . . Learning in situ engages different socio-cognitive processes than learning in schools. (A. A. Carr et al., 1998, p. 6)

Again, we can see parallels between our three approaches here. For language learning contexts, the demands of situated learning have always been a central problem for two reasons. First, especially in foreign language contexts, the distance to the target language culture and its speakers seem to present an insurmountable obstacle. Second, situated learning emphasizes at its core the importance of sociocultural context for

language learning. In this respect, situated learning focuses our attention on the indexical nature of language (Brown, Collins, & Duguid, 1996).

After looking at three major influences of learner autonomy, we want to look briefly at one practical implementation of its concepts, tandem learning. Tandem learning has three principles: reciprocity, bilingualism, and learner autonomy (Little & Brammerts, 1996). In a tandem learning partnership, two language learners with reciprocal combinations of target and native language (e.g., an Irish student learning German and a German learning English) are brought together in a learning partnership. Both partners agree to communicate in both languages in equal amounts (the principle of bilingualism). They also agree, for instance in the area of discourse management, to help each other as much as possible and to put as much effort into the relationship as possible. As both partners are in the same situation of learning a language, while adopting different roles as native language expert or target language learner this relationship is often perceived as highly motivating (Ushioda, 2000). Tandem learning has so far been successfully implemented in face-to-face, e-mail, and MOO partnerships (for a more detailed look at e-mail tandems, see C. Appel & Mullen, 2000; M. C. Appel, 1999; Little et al., 1999; for MOO tandems, see Aarseth & Jopp, 1998; Donaldson & Kötter, 1999; Schwienhorst, 1999, 2000).

We have explored the concept of learner autonomy from three different perspectives: an individual-cognitive, a social-interactive, and an experiential and experimental view of learning. We have also seen that these three approaches share a number of beliefs about learning. However, their concerns and implications for language learning have only partially been addressed in early CALL.

In our next section, we will therefore look at how virtual reality concepts can help designers and educators alike to create more effective CALL materials or, more exactly, CALL environments. It is also hoped that we can contribute to the definition of the term *virtual environments*, which is increasingly mentioned in recent CALL publications.

VR concepts for CALL

Before we look at the possible benefits of VR for CALL, let us examine some of the ways in which VR has been defined. A number of researchers have come to see VR not so much in the context of new tools and programs but in terms of a totally new concept, a paradigm shift in human computer interfaces, and a fundamentally different way of using computers. Bricken, for example, sees a shift on several levels: from "picture → place, observe → experience, use → participate, interface → inhabit" (W. Bricken, 1990; see also M. Bricken, 1990).

Hamit (1993) noted that "the term VR [was] devised, by some accounts, at the MIT in the late 1970's, to express the idea of human presence in computer-generated space" (p. 9). According to Veronica Pantelidis (1993), "VR has been defined as a highly interactive, computer-based, multimedia environment in which the user becomes a participant with the computer in a 'virtually real' world" (p. 23). Foster defined VR in a

social context as "some form of immersive, synthetic environment which creates a feeling of presence or suspension of disbelief which is sufficient to make the user feel that the artificial world which they appear to inhabit is 'real' " (Foster & Meech, 1995, p. 210). Markley (1996) quoted the definition of cyberspace by Marcos Novak:

> Cyberspace is a completely spatialized visualization of all information in global information processing systems, along pathways provided by present and future communication networks, enabling full copresence and interaction of multiple users, allowing input and output from and to the full human sensorium, permitting simulations of real and virtual realities, remote data collection and control through telepresence, and total integration and intercommunication with a full range of intelligent products and environments in real space. (p. 3)

These quotations point to several important concepts. As VR strives to immerse or absorb the user/learner in a more learner-centered and learner-controlled computer-generated environment, it can lead to higher cognitive engagement than traditional classroom learning. VR facilitates access to resources and tools because it makes use of interface structures that we use in the real world. VR also improves interaction between participants, as compared to other one-to-one conferencing systems, as its shared environment enables learners to use indexical language and (e.g., in the case of text-based VR) can provide them with a complete conversation record that becomes available as a future learning resource.

Central to the discussion of VR is the concept of presence. Biocca (1997) formulated a threefold model of presence. He distinguished between the notion of self-presence, involving notions such as self-consciousness and identity; "being with another body," the illusion of social presence with other users; and "being there," that is, "the sense of physical presence in cyberspace" (see also Loomis, 1992). Following this model, we will examine how these concepts can support learner autonomy in language learners.

Supporting reflection: Awareness of self, others, and language resources

Biocca's (1997) concept of self-presence has obvious parallels with the concept of awareness. Rather than trying to minimize or ignore the differences between objective body and virtual body (or telecommunicated body), as in many current point-to-point communication systems (ICQ, e-mail, etc.), learners could use a virtual body for experimentation. Biocca emphasized that in every virtual environment there are three bodies present: the objective body, the virtual body, and the body schema or self-image. This body schema, the mental model of the user's body, "may be influenced by the mapping of the physical body to the geometry and topology of the virtual body," whereas "the virtual body may have a different social meaning (i.e., social role) than the user's body" (Biocca, 1997). The re-creation of self has long been noted in text-based virtual environments such as MUDs and MOOs (Turkle, 1995), and some of its

effects have been noted in CALL projects that have used VR. Rose and Billinghurst (1995) and Rose (1996) noted the stress-free environment that VR creates, and Sanchez (1996, p. 153) claimed that the virtual presence reduces the affective filter and encourages role playing, as there is less apprehension and less embarrassment. Kelly (1963, pp. 161-162) emphasized the importance of experimenting with different roles. This should not be misunderstood as role playing as in "at the train station" scenarios in some language classrooms but in the more fundamental sense of using alternative personas to approach potentially construct-altering situations without the negative consequences expressed in Kelly's organizational, modulation, and fragmentation corollaries, for example, in the affective domain. We have already noted that tandem learning is an appropriate framework for the experimentation with different roles.

We should also note that VR tools can offer different communication tools from face-to-face communication. Thus, MOOs offer communication commands that present "thought bubbles" in the form of "Ralf thinks o O IRS??" This and similar commands invoke different responses than "Ralf asks, 'IRS?' " Biocca (1997) called this hyperpresence, Walther (1996, 1997) and Parks and Roberts (1997) hyperpersonal. However, this example should not suggest that users develop rather obscure ways of communicating that have no value in a wider context. The example shows that users may develop compensatory communication strategies over time. In our given example, a face-to-face communication would probably solve the question through whispering. In addition, many telecommunications tools such as MOOs allow the user to record conversations in so-called logs, which can form valuable material for reflective offline work (Sanchez, 1995). These records cannot only serve to provide learners with, by definition, personally meaningful authentic material in the target language but allow them to critically examine their own performance, or rather, the performance of their virtual selves.

Supporting interaction: Collaborating with native speakers, peers, and virtual agents/bots

The vital difference between interaction in VR and interaction with non-VR telecommunications systems was formulated as the "coffee and biscuits" problem by Short, Williams, and Christie (1976) long before the Internet came into existence; both cannot be passed to a partner in telecommunications:

> Even a full-color life-size three-dimensional motion-picture transmission of the complete body of the distant person by some futuristic television system, although a complete replication of the face-to-face situation in its reproduction of non-verbal and verbal cues, would not . . . be exactly the same as face-to-face contact as long as the interactors are aware they are separated. The knowledge of physical separation may suffice to make the telecommunicated interaction more like other telecommunicated interactions, rather than like face-to-face. (pp. 158-159)

The fact that many telecommunications systems emphasize that the parties are in separate spaces and contexts automatically precludes a variety of discourse elements, such as indexical language (*here*, *this*, etc.). We can also find the concept of copresence in discourse analysis literature that has investigated these features. Clark and Marshall (1981, pp. 38-40) talked about the importance of mutual knowledge, which involves either physical copresence, linguistic copresence, or community membership of the interlocutors. In text-based VR, physical presence merges with linguistic presence.

Although this is certainly the most important benefit of VR for interaction, any telecommunications tool also needs to support the multitude of communication scenarios in the language classroom and target language community. This involves the provision of asynchronous and synchronous communication tools in the same environment but also the dynamics of group formation that usually occur in classroom interaction. Thus, the teacher may work with a student, two students may work together, a group of four students work together, and so forth, and this is a constantly changing process. Both Dam (1995, pp. 26-27) and Tort-Moloney (1997) emphasized cooperation in their approaches to learner autonomy. Again, VR can support these ever-changing scenarios by providing environments and tools; for example, the MOO provides tools to contact other users privately, it allows users to whisper or contact people in other rooms, users can quickly change between groups, and so forth. Pinto (1996) reported the usefulness of MOOs for the development of conversation management skills. Ma (1996) reported greater self-disclosure and a more egalitarian exchange than face-to-face communication, and increased intercultural awareness (supported by Falsetti & Schweitzer, 1995). It is important to notice that the written mode for synchronous communication has a number of advantages over audio or video conferencing. Little (1997) noted the importance of writing to support orality and develop linguistic and metalinguistic awareness (see Olson, 1977; Tannen, 1982; Wells, 1981). In this way, VR in general and text-based VR in particular can contribute toward language and linguistic awareness, while providing a more stress-reduced and egalitarian learning environment for collaboration and interaction between peers. This also means that learners who have not developed a high degree of learner autonomy can benefit more from a VR environment where they are encouraged to communicate, collaborate, and participate in the learning process, where they are encouraged and sometimes even forced to take control and assume responsibility of their own learning.

VR also supports the implementation of natural language processing (NLP) tools: "If convincing morphology is present, less intelligence may be required to fool the user into believing that a human intelligence is 'present.' Users may be fooled by convincing morphology and believe an artificially intelligent agent is really a humanly directed avatar" (Biocca, 1997). Research by the British Broadcasting Corporation (BBC) has shown that it becomes increasingly difficult for users to distinguish between human conversation partners and agents or bots (BBC, 1998, 1999). Kaplan successfully implemented a bot using NLP for the limited register of military language (Kaplan & Holland, 1995; U.S. Army Research Institute for the Behavioral and Social Sciences, 1995, n.d.-a, n.d.-b). Although still in its infancy, the use of agents and bots

for CALL seems a valuable area for research in the future. Although they cannot provide the flexible and individualized feedback function of peers or other native speakers, they can be useful for limited functions such as vocabulary training or message delivery, or as cognitive tools for learners to experiment with language.

Supporting interactivity and experimentation: Self-access, self-regulation, and manipulation in virtual environments

In this section, we will examine how VR can support experimentation. K. Carr (1995) summed up the major advantage of VR as an interface:

> Virtual reality reduces the need for abstract, extero-centric thinking by presenting processed information in an apparent three-dimensional space, and allowing us to interact with it as if we were part of that space. In this way our evolutionarily derived processes for understanding the real world can be used for understanding synthesized information. (p. 1)

This is what M. Bricken (1990) referred to as "natural semantics." Zohrab (1996), in his VR program for language learning, emphasized the importance of the essential realism of VR.

VR interfaces combine direct manipulation, hypertext, and conversational interfaces; Bardini (1997) showed the links between hypertext and VR:

> Design should be open-ended and subject to transformations resulting from the interaction of designers and users. Just as hypertext modifies the relationships between author and reader of the text and blurs the distinction between them (Landow, 1992; Tuman, 1992), the implementation of hypermedia interfaces in virtual space-like designs ought to allow a real connection of users and designers. This would be the ultimate meaning of interactivity.

Brennan (1990) showed the links between direct manipulation and conversation interface designs.

In a context of self-access and self-regulation, VR systems allow learners to actively participate in the collection and organization of their own learning resources and tools. In MOOs, for example, learners can create their own rooms and experiment with a variety of objects such as bots. The recently published EnCore MOO database (Holmevik & Haynes, 2000) provides a particularly easy-to-use interface for the creation of new objects. Donaldson and Kötter (1999) demonstrated how learners take control of the resources in a tandem MOO project. Rooms also allow them to organize relevant multimedia material from the Internet. This may be supported by a multimodal interface that allows users to access the virtual world by text commands, hypertext links, or through 3-D objects. Negroponte (1995, pp. 97-99) argued that redundancy actually supports the efficiency of computer interfaces. Examples for this variety of interfaces are Rose and Billinghurst (1995) and Rose (1996), who coupled physical activity with spoken commands and visual aids for vocabulary acquisition.

Trueman (1996), using QuickTime technology, showed how the manipulation of objects in real time leads to learning. Turner (1995), using text-based VR, used virtual treasure hunts and similar activities. In their experience, the 3-D aspect enhances attention and awareness of language resources, which in turn enhances classroom work.

An important feature of VR tools that still needs more development is shared applications. These are applications that can be shared in real time among participants in different locations, and have to a degree been realized in some shared whiteboards in MOOs. Shared applications can make task-oriented work more effective (Shield & Weininger, 1999). The creation and organization of resources (including learner diaries and conversation records) in a personalized online database is an important factor for the creation of cognitive and linguistic awareness. Tools and resources need to become cognitive tools (Brown, Collins, & Duguid, 1989; McLellan, 1996) or cognitive amplifiers (Bruner, 1972), tools that can be experimented with and tried on for size, to use Kelly's (1963, p. 9) expression. Learning cannot take place without the availability of validating data and its analysis by the learner (Kelly, 1963, p. 162).

Conclusion

This article began by exploring the concept of learner autonomy through three different approaches: an individual-cognitive view by Kelly, emphasizing learner awareness; a social-interactive view by Vygotsky, emphasizing interaction and peer collaboration; and an experiential and experimental view by Bruner, emphasizing active participation of the learner in the learning process. It then showed how VR concepts can support these approaches by looking at VR theorists and empirical CALL research using VR.

In this section, we want to summarize the advantages of virtual environments. In doing so, we also hope to contribute to a definition of the area:

- VR allows for greater self-awareness and encourages learners to experiment with different roles through the use of virtual representations, thereby reducing the affective filter.
- VR tools such as recording tools may go beyond face-to-face communication in the way they can enhance linguistic and cognitive awareness of the learning process, especially through the medium of writing.
- VR supports interaction by locating participants in a shared environment, thus allowing for a common linguistic reference point.
- VR can enhance conversation management and group work by allowing for collaboration in a variety of rapidly changing group work scenarios.
- VR also supports the implementation of NLP tools; these have been shown to be successful for limited context such as the military register.
- As an interface, VR with its underlying spatial metaphors is a more natural way of organizing information resources than an interface that relies solely on the use of buttons and/or menu bars, providing a multimodal interface to resources supporting learning.
- Shared VR applications enable learners to collaborate on resources in real time.
- In VR, learners are encouraged and enabled to actively participate in the creation and organization of their learning environment.

The implementation of VR concepts in CALL does not necessarily involve high-tech equipment; some ideas can well be realized in a text-based environment. There is still a lack of empirical research in this area, although more and more research, particularly on MOOs, is becoming available. Recent CALL publications have sometimes adopted the terminology of VR, but there is a danger that the term *virtual environments* could be misused to include any CALL program or tool. There is also still a widespread conception that the concept of virtuality contains the danger of learner isolation. Nothing could be further from the truth. VR is a necessary concept for CALL, in that it can bring language learners closer to the target language community and its speakers while also providing an array of tools for awareness-raising activities and critical reflection. Together with learner autonomy, VR enables students to become more successful language learners who can plan, monitor, and evaluate their learning process, and more successful language users who can collaborate on personally meaningful learning resources as much as possible through the target language.

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