Real and perceived affordances of Immersive Virtual Environments in a language teacher-training context: effects on the design of learning tasks

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REAL AND PERCEIVED AFFORDANCES OF IMMERSIVE VIRTUAL ENVIRONMENTS IN A LANGUAGE TEACHER-TRAINING CONTEXT: EFFECTS ON THE DESIGN OF LEARNING TASKS

AFORDANCIAS REALES Y PERCIBIDAS DE LOS ENTORNOS VIRTUALES INMERSIVOS EN UN CONTEXTO DE FORMACION DE PROFESORES DE IDIOMAS: EFECTOS EN EL DISEÑO DE LAS TAREAS DE APRENDIZAJE

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ABSTRACT

Research suggests that Immersive Virtual Environments (IVEs) offer potential solutions to transform experiential immersion into language competence and knowledge. Instead of accepting the theoretical considerations at face-value, the present study questions the sometimes superficial infatuation with IVEs by proposing a hands-on teacher-training classroom experiment. 18 teacher-participants enrolled at a Master's teacher training course for pre- and in-service English and Spanish teachers propose teaching scenarios that integrate IVEs in language tasks. In order to understand how future language teachers make use of this novel technology at hand, the researchers question how the "real" affordances of IVEs (extracted from our literature review) are perceived by the teacher-participants. A mixed analysis of eleven learning scenarios reveal utilization schemes that demonstrate how IVEs are "instrumentalized" (RABARDEL, 1995) for use and perceived by participant-teachers as a potential support for language and culture learning. The results open the floor for questions that discuss whether IVEs are indeed a complementary resource among other authentic resources used in the classroom and whether they lead to a renewal of language learning practices

KEYWORDS: affordance - immersion - language learning - scenarios - virtual reality

RESUMEN

Las investigaciones sugieren que los Entornos Virtuales Inmersivos (EVI) ofrecen soluciones potenciales para transformar la inmersión experiencial en competencia y conocimiento del lenguaje. En lugar de aceptar las consideraciones teóricas en su valor facial, el presente estudio cuestiona el encaprichamiento, a veces superficial, con los EVIs proponiendo un experimento práctico de formación de profesores en el aula. 18 profesores participantes inscritos en un curso de formación de maestros para profesores de inglés y español antes y durante el servicio, proponen escenarios de enseñanza que integran las EVIs en las tareas lingüísticas. Con el

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fin de comprender cómo los futuros profesores de idiomas hacen uso de esta novedosa tecnología a su alcance, los investigadores se preguntan cómo perciben los docentes-participantes las posibilidades "reales" de las EVIs. Un análisis mixto de once escenarios de aprendizaje describe esquemas de utilización que revelan cómo las EVIs son "instrumentalizadas" (RABARDEL, 1995) para su uso y son percibidas por los profesores-participantes como un apoyo potencial para el aprendizaje de la lengua y la cultura. Los resultados abren la puerta a preguntas que discuten si las EVIs son realmente un recurso complementario entre otros recursos auténticos utilizados en el aula y si conducen a una renovación de las prácticas de aprendizaje de idiomas.

PALABRAS CLAVE: afordancia - inmersión - aprendizaje de idiomas - escenarios - realidad virtual

INTRODUCTION

Immersion in natural situations is seen as very favorable for language learning since the learner is exposed to the target language in a rich quantity and quality, thus supporting the development of their language skills (KRASHEN, 1982; SWAIN, 2005). However, one of the stumbling blocks of immersion is that learning is largely self-directed making it responsible for transforming the resources of a learner's environment (e.g. feedback from native speakers) into learning resources. A study of the effects of stays abroad on the development of learners' language and cultural skills (SERCU, 2005) suggests that the absence of specific formative mediation during immersion would reinforce cultural stereotypes and barely contribute to the development of learners' interlanguage skills if they are not already able to comprehend their linguistic limitations. Numerous studies on interactive language learning, whether online or face-to-face, show that the social stakes of communication tend to outweigh the formative issues – speakers often prefer to save face for their partners' sakes instead of inviting them to correct their mistakes (CIEKANSKI, 2017). Virtual reality (VR) including 3D Immersive Virtual Environments (IVEs) are emerging as relevant solutions for rethinking immersion in training contexts. Learning through IVEs is based on learning by simulation and the three-dimensional aspect of such devices makes it possible to go beyond the fictionality of traditional simulations in terms of cognitive, physical and emotional engagements of learners in live interactions (MOLLE, PRIVAS-BREAUTE & CIEKANSKI, 2020). Communicative intentionality, which depends on the consideration of the action and the addressee(s) in context (REICH, 2011), would thus, we contend, be closer to what exists in a real-life situation of communication.

Learning through IVEs might therefore be viewed as a form of situated learning (LAVE & WENGER, 1991), generally considered to be conducive to the development of social practices. For Brougère (2012), the "playful" nature of learning devices such as serious games reinforces the possibility for human beings to learn from experience and supports a high degree of motivation among participants. Moreover, Fuchs and Moreau (2003) argue that

behavioural interfaces where action and perception support cognition have a generally positive effect on learning.

For Brudermann *et al.* (2018), initial and continuing education of foreign language teachers in the digital age is constantly being confronted with the need for more multidimensional professionalization that targets mediation[5] (BRUDERMANN *et al.*, 2018). However, any novel form of teacher training that aims at a potential "transformation of society" (BURROWS & MIRAS, 2019) will be in need of adequate support in order to reduce the concerns that emerge during such a process. It seems only logical then that future teachers should not only be made aware of professional skills at play but also of the patterns that emerge at the interplay of their teaching activity and potential effects that may ensue (CICUREL, 2011). Finally, they should be encouraged to devise practical projects that combine both their professional training and the transfer of knowledge to their (future) pedagogical fields (ABENDROTH-TIMMER, 2017).

Keeping this context in mind, we will seek to understand how future language teachers perceive the use of IVEs in order to create teaching resources. The following section will shed light on some of the principal theoretical considerations that have provided a backdrop for this study, and the research protocol will be detailed in the method section of this paper.

THEORETICAL FRAMEWORK

"Virtual reality": a confusing and polysemic expression

In his work regarding the notion of presence in virtual reality, Bouvier (2009) insists on the grey area surrounding this new technology for the term "virtual reality" is rather confusing. Indeed, when taking a closer look at it, "virtual reality" is an oxymoron *per se*. To understand the reason behind the coining of this term, it is necessary to go back to its historical roots[6]. Jaron Lanier, the founder of a new technology company, VPL Research, presented datagloves and head mounted display at a trade fair in 1989. In order to draw more attention to his innovative new tech products, Lanier looked for a catchy expression and coined the term "virtual reality" for marketing purposes. Although the expression has been widely popularized since then, it seems to beg confusion. Firstly, even if "virtual" is easily understood as "not physically existing as such but made by software to appear to do so"[7], the

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[5] "La formation initiale et continue des enseignant·e·s de FLE à l'ère du numérique se voit confrontée au besoin d'une professionnalisation multidimensionnelle visant la médiation." (BRUDERMANN *et al.,* 2018, p. 31).
[6] For a full historical study of virtual reality, see Rheingold (1991) *Virtual Reality*.
[7] Definition taken from the Oxford English Dictionary (OED) online.

first meaning of the word "virtual" has been in existence since the 14th century: "almost or nearly as described, but not completely or according to strict definition."[8] Consequently, in our day and age, for most people, virtual reality is understood as "another reality generated by a computer" whereas it was initially meant to mean "almost reality".

The second source of confusion is to be found in the very definition of virtual reality because no definition has, as such been agreed upon. As Lloyd, Rogerson and Stead put it, the "term is somewhat controversial" (2017, p.222). Indeed, each research field has its own term acceptance, and this results in a diversity of definitions. Thus, a multiplicity of purely technical, functional and cognitively-oriented definitions are to be found. However, the purpose of virtual reality seems to lead to a general agreement and Fuchs' following vision is accepted by all:

> The purpose of virtual reality is to make possible a sensorimotor and cognitive activity for a person (or persons) in an artificial, digitally created world, which can be imaginary, symbolic or a simulation of certain aspects of the real world (FUCHS, 2017, p.9).

For this study, we have chosen to refer to the term "Immersive Virtual Environments" (or IVEs) instead of virtual reality since the former refers to a more structured human-made artifact as opposed to the latter epistemological construct.

Affordances of Immersive Virtual Environments (IVEs) for language learning

The neologism *affordance* was coined by Gibson (1979/2014) from the verb "to afford" meaning the action of allowing, offering, or providing the opportunity to do something. Norman (1988/ 1998) applied the concept to everyday artifacts to focus on the relationship between agent and object in order to better understand how to design everyday objects. Affordances are therefore defined as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (NORMAN 1988/ 1998: 9). While "real affordances" of an artifact could be viewed as any action possible to manipulate an artifact, "perceived affordances" refer to an action that a user *perceives* as being possible. The agent is thus at the heart of a reflexive approach that

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[8] The word "virtual" comes from late Middle English (meaning having certain virtues or capable of producing a certain effect). The origins of the word "virtual" are to be found in the Medieval Latin word *virtualis*, itself from the Latin word *virtus* meaning potency or efficacy. The acceptation "not physically existing as such but made by software to appear to do so" has been attested from 1959. The word first appeared in the paper *The Virtual Memory in the STRETCH Computer* presented at the Joint IRE-AIEE-ACM Computer Conference in Boston delivered by two computer scientists, John Cocke and Harwood Kolsky.

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allows "usability" (from an ergonomic point of view), "utilisability" (what the user does with the object) and "utility" (how the user perceives the object).

The concept of affordance is widely used in the field of Computer Assisted Language Learning (CALL) when it is appropriate to designate the functionalities of a technological product, a digital environment or a tool. Decisions and preferences are said to be based on feelings related to the positive or negative evaluation of the agent's interactions with the environment or the tool. Affordances thus imply a reciprocal relationship between actor and environment.

This approach is particularly interesting in order to apprehend the sometimes superficial infatuation that can be generated by IVEs (or the so-called "wow effect"). It also underlines the subjective nature of the evaluation of affordances. Affordances perceived by designers are not necessarily those retained by users (by extension, teachers may perceive educational affordances that may be different from those perceived by learners). The reciprocity between the user and the environment may change the perception one has of the environment or of the tool. Moreover, an interaction judged as pleasant by users can generate specific states of mind such as feelings of security, trust and satisfaction. Hancock, Pepe & Murphy (2005) propose a "hedonomic" dimension to affordances to qualify those interactions with environments or tools that generate positive emotional reactions. This may be particularly relevant to describe IVEs, which are mostly designed for purposes of entertainment and used during leisure time.

For this study, we have chosen to focus on three "real affordances" of IVEs that our literature review has helped identify. We argue that these three are not simply characteristics of an IVE, but affordances that allow the user to shape the oral, visual and gestural experiences lived with IVEs.

Interactivity

Interactivity is the first affordance that can be associated with IVEs. The construct of interactivity is not to be confused with that of interaction, widely used in literature on foreign language learning. In order to clarify the ambiguity brought about with the use of two seemingly similar constructs, Mangenot (2001) recommends reserving the term "interactivity" for human-computer (or digital) relationships, whereas "interaction" might refer to human relationships mediated through technology.

A relationship that is thus established between the user and the tool- IVE they use would indeed give the illusion of reality through sensorimotor elements. Thus, user and the

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technological interface constantly interact in what Fuchs has conceptualized as the "perception, cognition, action loop":

> The user acts on the virtual environment through the use of motor interfaces that capture his actions (gestures, movements, voices, etc.). These activities are transferred to the calculator [the computer] which interprets them like a request to modify the environment. In compliance with this request for modification, the calculator assesses the changes to be made to the virtual environment and the sensorial reactions (images, sound, effects, etc.) to be transmitted to the sensory interfaces. (FUCHS, 2017, p.11)

Immersion

Immersion is the second affordance that comes to mind when thinking about IVEs. For Slater *et al.*, an IVE is "immersive since it immerses a representation of the person's body in the computer-generated environment" (SLATER *et al.,* 1995, p.204). Immersion is made possible thanks to several elements such as the visual information that is provided by the device. However, visual immersion may be further enhanced by other parameters such as sensorimotor contingencies and illusion (PEREZ-MARCOS, 2018). Miller and Bugnariu (2016) have highlighted three degrees of immersion that can be felt by the user depending on the quality of the immersive tool used: low, moderate and high. As a consequence, tools that enable virtual reality are seen as the most highly immersive technology according to the researchers.

Feeling of Presence

When immersion and interaction are not hindered by latency and sensorimotor inconsistencies, a feeling of presence may appear (STEUER, 1992; SLATER *et al.* 1995; BOUVIER, 2009), which we will understand as the third affordance of IVEs. Steuer had suggested in 1992 that "the key to defining virtual reality in terms of human experience rather than technological hardware is the concept of presence." (1992, p.75). Later, Slater described presence as the "psychological sense of being there in the environment" (1995: 204). For Lloyd, Rogerson, & Stead, presence is included in their definition of virtual reality: "an immersive computer-enabled technology that replicates an environment and allows a simulation of the user to be present and interact in that environment." (2017, p.222).

Presence may then be considered as an individual, emotional and subjective answer to an immersive environment. For Bouvier, a *feeling* of presence may only appear provided the experience is deemed "believable" by the user who considers the experience credible, accepts

to take part in the game and, in response, feels a sense of presence[9]. However, for Slater, presence has nothing to do with "belief". According to the author, virtual reality is clearly a perceptual illusion:

> The perceptual system, for example, identifies a threat (the precipice) and the brain-body system automatically and rapidly reacts (this is the safe thing to do), while the cognitive system relatively slowly catches up and concludes "But I know that this isn't real". But by then it is too late, the reactions have already occurred. This is the real power of VR, and, like any illusion, even though you know it is an illusion, this does not change your perception or your response to it (SLATER, 2018, p.432).

Engagement: a positive effect on learning at the interplay of the three affordances

Engagement refers to the way in which participants invest themselves in the accomplishment of a task. It results from cognitive and motivational processes and depends on situational factors which modulate the "sense of commitment" that can be experienced (MICHAEL, SEBANZ & KNOBLICH, 2016). In IVEs, engagement refers both to the notion of *agency* (BUTLER, 2002), that is the capacity of subjects to act on their environment, on objects and on others, as well as the perception of this faculty by the subject, and to the notion of "flow" proposed by Csikszentmihalyi (1990), which characterizes the high degree of absorption of a person in the accomplishment of a task. Flow refers to the total psychic immersion that coordinates the emotions felt in the accomplishment of the task. Previous studies on the use of 3D IVEs for target-language task performance (BORONA *et al.*, 2018; GIRVAN & SAVAGE, 2019; YAMAZAKI, 2018) show a positive effect on learner engagement and motivation in general. IVEs support expressiveness thanks to their multimodal nature. The contextualization that these environments promote facilitates memory and stimulates gestural and even full body interaction (ROY, 2017; SCHMOLL *et al.*, 2014). Their use increases learner engagement, strengthens immersion through simulation and collaboration, reduces anxiety (because learners act through robots/avatars), supports motivation, increases confidence and the feeling of self-efficacy since the fictional nature of the game facilitates risk-taking. As a simulation device, they provide a reference universe (a place such as a city, a building; an action such as a guided tour, a professional meeting) and function as a framework that is both a thematic setting and a universe of discourse, stimulating all the language functions that this framework is likely to generate such as verbal interactions and language productions to name but a few. 3D IVEs are therefore suitable arenas for language learning: they make it possible to test reality in the absence of reality and to better master the

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[9] "L'utilisateur juge crédible l'expérience, accepte de se prendre au jeu et en réponse ressent un sentiment de présence." (BOUVIER, 2009, p.12).

language and the communicative behaviour adapted to the day when the learner will encounter the real situation in question.

Moreover, Peterson *et al.* note that "the presence of customizable personal avatars enhances the sense of immersion, telepresence and emotional investment experienced by learners promoting participation" (2019, p.4). Indeed, "embodied in avatars, language learners may be fully immersed in the simulated virtual life and go beyond context boundaries to learn a foreign language without physically stepping out of their home countries". (WANG, 2012, p.10). When IVEs are incorporated into the flow of language learning environments, they "not only amplify what humans do, but also shape human cognition by facilitating the construction of mental representations of abstract concepts and phenomena through the use of advanced computer visualizations and simulations." (ANGELI, 2008, p.271). Avatars, which we can consider as a mental image of the body of the actor/user, invite us to redefine our perception of the physical body and highlight the existence of a new metaphorical one, as a new resource to explore social virtual reality.

Finally, 3D IVEs fit into recent developments in language learning and use, that include an increased focus on listening and speaking, characterized by the emphasis on the development of oral skills, authenticity in communication, the use of real-life settings, the development of interactive skills via social practices (web 2.0), the use of multimodality to facilitate language learning and the development of informal learning practices as a complement to language learning (SOCKETT, 2014). All these elements constitute a favorable ground for the integration of those resources in language teaching-and-learning practices. In addition, they also respond to various challenges of language teaching-and-learning. Dubreil and Thorne (2017) call for the cultivation of social pedagogies as a means to "bridge the gap between pedagogical amplification in classroom spaces and social action in the world, ultimately giving students the translingual and transcultural tools to participate effectively in complex and diverse communities in the future" (2017, p.6). Framing L2 pedagogical practices as social pedagogies is an incentive for language educators to seriously envision what it would mean to manage the interface between formal and informal learning contexts and to relate this interface directly to instructed L2 course design (SAURO & ZOUROU, 2019). 3D IVEs appear, in this regard, to be a relevant solution for rethinking immersion in a formal learning context. Communicative intentionality would thus be closer to what exists in a real communicative context.

Towards an appropriation of IVEs by future language teachers

As a learning support, a 3D IVE offers various possible uses: playing different roles based on the teacher's instructions; virtual trips to several popular cities, worldwide monuments or museums; spontaneous conversational scenarios among the learners or with native speakers of the virtual world; individual quizzes by interacting with the objects and the non-playing characters of the environment; maze games where learners have to find the way out of the labyrinth by interacting with several objects and by answering quiz questions, etc.

All these practices fall within and illustrate several learning theories: a Vygostkian socio-constructivist learning perspective in which learning occurs through social interactions and collaborative construction of knowledge, the Piagetian cognitive theory in which learning is an internal process that occurs through interaction with the environment. They also echo the natural approach by Krashen which focuses on vocabulary acquisition, the understanding of messages in the target-language and the principle that communication is above grammar rules, as well as a complex dynamic systems (LARSEN-FREEMAN & CAMERON, 2008; TOMASELLO, 2003) promoting learning contextual strategies such as establishing joint attention, understanding the communication intentions of others, forming categories, detecting patterns, imitating, noticing novelty and having the social drive to interact with others.

A number of researchers in France (K.-THAPLIYAL, 2014; RIVENS MOMPEAN & GUICHON, 2013; RABY, 2005) recommend applying Rabardel's theory of the instrument in order to better conceptualize how a digital tool or environment might be appropriated by the users. Rabardel (1995, p.49) uses the term "artifact" to define the human-created object. While an artifact might be prescribed for use within the scope of an activity, it may not, at least in its present state, consider the relationship between the user and the said object. However, when the artifact is appropriated by the user, it becomes an "instrument", a tool used constructively within the activity. This process is what the author calls "instrumental genesis". In a nutshell, the concept of instrumental genesis "encompasses both the evolution of artifacts as the user's activity unfolds, and the building of utilization schemes, both of which participate in the emergence and development of an instrument" (RABARDEL, 1995 as quoted in RIVENS MOMPEAN *et* al., 2013, p.38).

We contend that research that aims to better understand user appropriation of IVEs would be incomplete if the building of utilization schemes based on the affordances perceived (K.-THAPLIYAL, 2014; NORMAN, 1988) by the user are left unexplored. Since the present study has chosen a teacher-training context of tool use, it seems logical to explore the multifarious ways in which IVEs might be imagined for pedagogical use by future teachers.

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In light of our literature review, we will address the following research question in this paper: How do future language teachers perceive the affordances of IVEs in potential language learning tasks and what utilization schemes of IVEs emerge during the process of preparing language learning scenarios?

METHOD

Project design and participant profile

The present case study was carried out as part of a Master's teacher training course for pre and in-service English and Spanish teachers contracted to secondary schools in the region of Lorraine (France). 18 participant-teachers (Appendix 1) were involved in the project. Eleven participants were female and the average age of all the participants was 26. An analysis of participant profile reveals that ten teachers teach Spanish as a foreign language whereas eight teach English as a foreign language in French middle schools (n=9) and high schools (n=9).

The objective of this course was to make learners aware of the stakes of virtual reality and IVEs, to get hands-on experience with the technology at hand, and appropriate it, in order to create potential learning scenarios for middle and high school students.
Given their limited professional experience with implementing pedagogical devices in the classroom, the teacher-researchers decided to invite the participant-teachers to actively participate in an innovative co-constructed project wherein the appropriated IVE tool would be potentially adapted for use in the participants' own classes. For this purpose, the participant-teachers were invited to propose an educational scenario integrating virtual reality and/or IVEs. In their respective scenarios, the participants, in pairs or on their own, had to reflect upon the importance of interactions and collaborative work in foreign language learning facilitated by IVEs.

During the course of the semester, they were introduced to a variety of IVEs and trained in the main pedagogical trends (Figure 1). The virtual reality room that was used is located in the Yves Chalon language centre of the university[10].

Three sessions allowed the participants to discover and become familiar with IVEs. A reminder of the didactic approaches underlying the teaching of languages in communicative

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[10] Funding was granted to the site's English for non-specialists department under the MutaCamp programme in September 2017 to provide students with the latest facilities. This room has been operational since March 2018. The equipment used is provided by the Oculus® operating system under Microsoft®

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and action-oriented approaches as well as a course defining the stakes of virtual reality in a learning context were offered to help participants better situate themselves within this project. These sessions allowed learners to reflect on the reasons why we may introduce multimodal practices in support of language learning, and the complementarity of verbal and non-verbal behaviours, including emotions and corporality, in communicative interactions.

Data collection

Research was conducted over one semester that was composed of six blended-learning sessions of two hours in-class instruction and six weeks of distance work with one hour of prescribed work per week from September 2019 to January 2020.
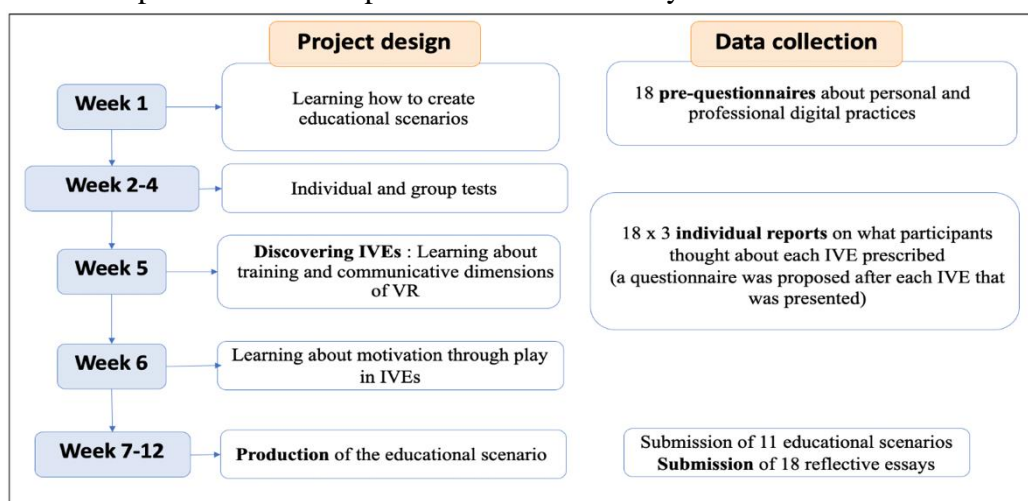

Figure 1: Project design and data collection

As indicated in Figure 1, both qualitative and quantitative data were collected. A pre-questionnaire was distributed to the participants in order to take stock of the personal and professional practices of the digital technologies. Participants were then offered to try out several applications proposed by the Oculus® operating system. While some applications propose listening activities in a foreign language (mainly English), such as "The House", where Barak and Michelle Obama take virtually-connected participants on a tour of the White House, others such as Google video 360° on YouTube or Google Street Views, allow participants to visit any part of the world guided or not by a native speaker. Furthermore, applications such as Sansar®, engage participants in a 3D virtual world that allows them to communicate synchronously with other connected users via a self-defined avatar. Some students could not access the VR room and used their digital tablets or smartphones.

Halfway through the course, the participants had to fill out reports conveying their first impressions of the proposed applications. Their final task consisted in proposing an educational scenario integrating an IVE and they needed to complete this proposal with a reflexive essay justifying and defending their didactic and pedagogical choices in light of what they had studied.

For the purposes of this paper, we have chosen to analyse only the scenarios proposed by the participants in order to uncover utilization schemes (RABARDEL, 1995) of the appropriation of IVEs. This, we hope, will in turn help to determine the role of IVEs as an authentic resource when it comes to integrating them in foreign language learning and teaching.

Description of the multi-criteria grid

A mixed analysis of eleven scenarios was performed by three coders using a 34-item multi-criteria grid (Appendix 2); coding criteria were discussed by the team and applied systematically so as to limit interpretation bias. The grid aims to describe the learning scenarios designed by the participants, with respect to their educational, technological and didactic aspects:

1. The learning situation: target language; level of the learners; school level; thematic integration in the curriculum (Figure 2);

2. The characteristics of the IVE chosen: the type of IVE; the tool used; design elements and affordances of the IVE according to the degree of immersion, type of interactivity, degrees of presence and commitment (Figure 3);

3. The characteristics of the educational scenario designed: emic (1st person)/etic (3rd person) perspective[11]; the role of the learner (language learner/language user); the learning goals (skills; learning content); the nature of the activity (type of activity, collaboration, guidance, feedback and evaluation).

The interpretation of the coders was cross-referenced with the justifications given by the students in their educational scenario. This enabled us to take into account the students' pedagogical intentions, even when they were little or poorly exploited.

RESULTS

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[11] The terms "emic" and "etic" come from the field of Anthropology. They designate two different perspectives for studying a group or a milieu. The "emic" perspective is used to designate the point of view of a person immersed in a group or a milieu, as opposed to the "etic" perspective which refers to a point of view outside the group studied. The objective of the "emic" perspective is a deeper and more subjective understanding of a reality.

The cross-referencing of the criteria presented in §2.3 of this article reveals how participants perceive the empowering affordances of IVEs that stimulate informal language learning, as well as their ability to integrate these resources into a learning task for a given audience. The results presented below will thus give us a better understanding of how the participants cope with the authentic dimension of IVEs, what the educational scenario proposed by the participants brings and what becomes of the teacher's role in this process of language teaching and learning.

Categorization of scenarios proposed by the participants

Eleven scenarios were proposed by the 18 pre- and in-service teachers who participated in this project. The following table (Figure 2) briefly outlines the learning situation through various characteristics of the scenarios and the target audience: title and general pedagogical objective of the scenario, CEFR language level that was targeted, age of the target audience and the skills targeted.

ID	Title of the scenario	General objective	Target Language level (CEFRL)	Target audience (approx. age)	Skills
Scenario 1	The Discovery of America by Spanish Sailors	To be able to make an account of an historical event: The Conquest of America	A2 /A2+	14 years old	Writing
Scenario 2	How Does Dystopian fiction warn us about the dangers of technology?	Understanding the dangers of technologies on societies	B1	17 years old	Oral interaction
Scenario 3	Fiesta Moros y Cristianos de Alcoy	To be familiar with an original document and to talk about it in a simple way	A2 to B1	15 years old	Oral interaction, Writing
Scenario 4	Discovering Others through Games, Sports: From pre Columbian Era to Nowadays	To discover pre Columbian civilization through arts and social relations	A1 to A1+	13 years old	Listening, Speaking
Scenario 5	How to be a New York Guide	To discover New York City	A2 to B1	15 years old	Listening, Speaking
Scenario 6	Un recorrido por la herencia musulmana a través de los siglos y monumentos en Córdoba	To discover the Cathedral-Mosque of Cordoba	A2 to A2+	15 years old	Listening, Speaking
Scenario 7	Un día en la feria	Representation of other cultures through popular traditions	Not mentioned	14 years old	Oral interaction, Writing
Scenario 8	Superheroes Protecting New York City	To be able to express emotions/ Use of "there is/are"	A2	12 years old	Not mentioned
Scenario 9	New York as a Movie Set	Not mentioned	Not mentioned	Not mentioned	Speaking
Scenario 10	In What Way are Winter Celebrations Anchored in New York Traditions?	To discover New York city and be able to understand leaflets and commercials	A2 to B1	14 years old	Listening, Speaking
Scenario 11	Immigrations: Dreams and Realities	Cultural, linguistic and pragmatic	A2 to A2 +	16 years old	Listening, Speaking

Figure 2. Scenarios proposed by the participants

Technical characteristics of the IVE chosen

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Figure 3 highlights the technical characteristics of the IVE chosen by the participants, the IVE support, type and devices suggested by the scenario.

ID	IVE Support	IVE Type	Devices suggested	Target language
Scenario 1	Youtube Video	360° video	Cardboard VR Glasses	Spanish
Scenario 2	Sansar Application	Virtual world with avatar	VR Helmet	English
Scenario 3	Youtube Video	360° video	Smartphones	Spanish
Scenario 4	Google Street View	360° video	Cardboard, VR Glasses	Spanish
Scenario 5	Youtube video	360° video	Smartphone or laptop	English
Scenario 6	Video	360° video	Smartphone, VR Helmet	Spanish
Scenario 7	Youtube video	360° video	Smartphone, VR Helmet	Spanish
Scenario 8	Youtube video	360° video	Smartphone, VR Helmet	English
Scenario 9	Youtube video	360° video	Smartphones, laptops and VR Helmets	English
Scenario 10	Youtube video	360° video	Tablets	English
Scenario 11	Youtube video	Google VR + 360° video	Tablets or laptops	Spanish

Figure 3. Technical characteristics of the IVE chosen

Feeling of presence linked to immersion

The feeling of presence felt by the participants is an (inter)subjective construct that depends on the social stimuli provoked by the tool and/or by the educational scenario that the participants have to play in the IVEs and/or by the use of a VR helmet or VR glasses. It also depends on the stimuli caused by the tool's affordances, i.e. the set of possibilities and constraints of the digital environment that give participants different options for action. IVEs allow for interactions with the interface of the tool (moving, zooming, etc.) or within the tool with others or with the environment implying a spatiality of situations for action (changing points of view). Thus, learning in IVEs is both a social and an ecological process. Learning may be a social-drive and an eco-drive process[12]. In the analysis of the scenarios created by the students, we look specifically at how students used the affordances of the selected IVEs to achieve the intended learning objectives.

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[12] An eco-drive process refers to a learning process based on the different stimuli coming from the environment (taking into account the different elements composing the setting of the communicative situation for example).

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The following figure (Figure 4) highlights the affordances of IVEs perceived by the students as potential vectors of learning by immersion. Most of the selected IVEs are 360° videos (see IVE type in Figure 3 and Appendix 3). The resources chosen are therefore above all resources in which the visual modality is central to the interactions with the IVEs. For Gibson (1979/2014), vision is linked to the possibility of interaction offered by the elements of the environment. However, as immersive videos, the stimuli of the IVEs are also aural and haptic, which generate sensitive experiences.
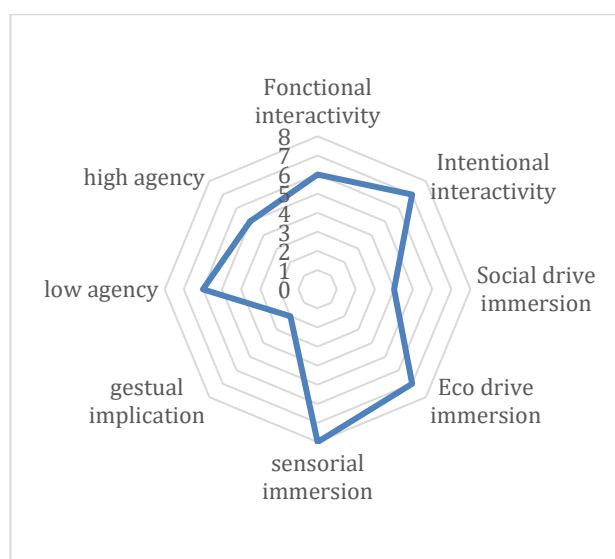

Figure 4. Perceived immersive affordances (in number)

In our dataset, most of the scenarios proposed immersion in a place that is supposed to stimulate learners' attention and learning (eco-drive immersion), whereas one scenario chose interactions with avatars as an immersive situation (social-drive immersion). Most of the scenarios (n=8) involved sensorial immersion (watching, feeling, experiencing). However, concerning functional interactivity, apart from visualization and moving gestures, no gestural implication seems to be called for in the scenarios. One might wonder whether this leads to poor agency within the IVEs. Nevertheless, interacting within IVEs allows one to participate in the realization of the tasks. These interactions are mostly intentional, i.e. they respond to strategies for using the medium to learn linguistic or cultural elements. However, few scenarios propose completing a task entirely within the IVE, leading to a strong sense of immersion among participants (scenarios 2, 4, 6). Most of them involve working more *with* IVEs than *in* IVEs (scenarios 1, 3, 5, 7, 8, 9, 10, 11).

The communicative situations created are, as a result, hybrid, taking place in a space-time continuum involving the IVE used and the classroom. The linguistic interactions between the

learners create an interactional unity that guarantees joint action on the task in question (information gap; treasure hunt; presentation of NYC). In these formative situations, the language stimuli come more from the classroom than from the IVE, generating, in our opinion, a weaker sense of immersion, and maybe a higher risk of nativisation in L2, due to the fact that learners interact with each other.

Interactivity targeted by scenarios

Figure 2 demonstrates that the scenarios proposed by the participants are mainly based on the realism of the IVEs (*realistic surroundings*) such as visiting sites (NYC, Machu Pichu) or experiencing real events (Feria in Andalusia). However, the affordances of the chosen resources allow little interactivity or interaction as we have previously mentioned. The learners are mainly spectators who *move around* in a setting rather than actors/agents who act with a medium (*interaction with others; assembling objects; basic interaction with objects*), irrespective of the use of glasses and helmets.

We can consider visualization here as a specific digital gesture in IVEs and not just as "passive observation" since it is part of the action in order to complete a task (see and describe, show and explain, etc.). Movements as well do not correspond to a simple virtual walk but are integrated into co-actions (e.g. watching so as to describe a place or an event to other learners; explaining events or places to other learners; moving around to find a clue). The various interactive affordances targeted by the scenarios are presented in Figure 5.
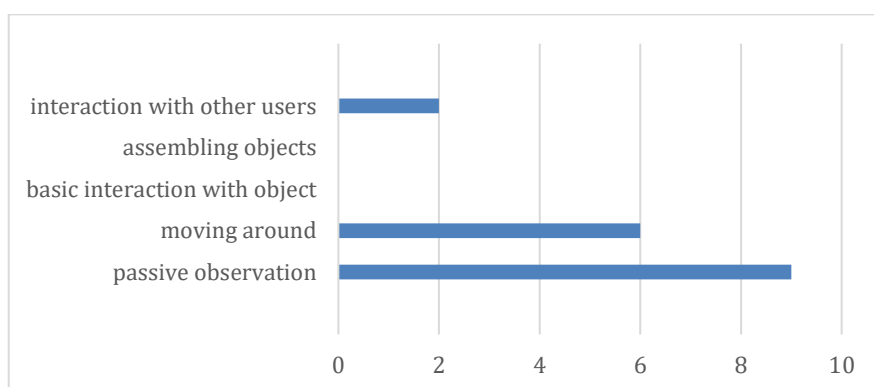

Figure 5. Interactive affordances targeted by the scenarios (in number)

The visual aspects of IVEs are among the first selection criteria for students. For some of them, the environment is a *setting* for an action carried out outside the IVE; for others, the environment is perceived as a *framework* for action. Only one scenario proposes to interact

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exclusively in the IVE, the others articulate the language interactions that take place between learners in class with the actions that take place in the IVE, regardless of the tool used – smartphone, cardboard or VR glasses/ helmets.

Immersive learning targeted by the scenarios

As mentioned previously, immersion learning is not just contact learning. This contact implies different kinds of learning that we have tried to find in the scenarios, taking into account the targeted learning objectives and the pedagogical approach that underlies the tasks. Two-third of the devices involve a low degree of immersion. This low or high degree of immersion can be linked to the device that is used. The more students use the VR headsets/ glasses, the higher the immersion. Most of the scenarios propose hybrid devices (IVE and classroom) in which sometimes only one learner experiences immersion. Two explanations can be provided: the consideration of technological under-equipment in the classroom by the participants or the need for teachers to control a) the activity experienced by the learners and b) the equipment.

Therefore, we realize that the majority of the scenarios (Figure 6) aim at formal language learning (n=7). 50% of the scenarios (n=6) promote learning methods that are characteristic of immersive learning: incidental learning or imitative learning for 25% (n=3) and experiential learning for 25% (n=3). IVEs thus make it possible to promote (new) learning methods that are different from those more traditionally used in the classroom. However, those immersive experiences are mostly seen as vectors of emotion to facilitate communication; there are few reflexive tasks combined with experiences, although it is highly recommended for transforming experience-based learning into linguistic or cultural knowledge. IVEs thus seem to be perceived more as tools for sensory and cognitive stimulation than as mere supports for language learning simulation.
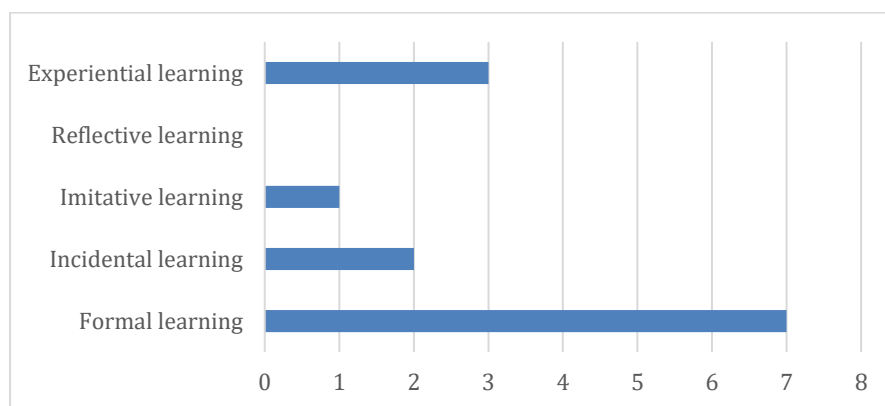
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Figure 6. Learning methods (in number)

DISCUSSION

By triangulating language content and learning aspects, we describe how IVEs are "instrumentalized" (RABARDEL, 1995) for use and are perceived by participant-teachers as a potential support for language and culture learning for a teenage audience. As for integration in teaching-learning practices, the scenarios shed light on several educational choices made by the learners in particular with regard to the aspects of language learning emphasized (linguistic/ cultural/ pragmatic), by the tasks and the chosen topic (Figure 2) in connection with the learning modality (incidental/formal/reflective) (Figure 6). These results raise two questions that we attempt to answer herewith.

Are IVEs a complementary or additional resource in the range of authentic resources used in the classroom?

The integration of a resource in a learning sequence implies a convergence between the technical and educational potential of the resource, the targeted objectives and audience. Our study shows that IVEs are perceived as relevant resources for teaching and learning English and Spanish in secondary school (A1-A2). In half of the scenarios, a cultural objective was chosen over a language objective (scenarios 3, 4, 5, 6, 10, 11). IVEs are generally chosen to illustrate and convey cultural practices. One might have expected a better consideration of the contextualization of communication proposed by the IVEs. However, this has barely been taken into account by the students: pragmatic and sociolinguistic objectives appear only in a quarter of the scenarios. The IVEs chosen thus complement the iconographic and video

resources traditionally used in the classroom. They offer new semiotic resources for communicating and learning a language. IVEs, as compared to multimodal videos, propose a distinctive "emic" perspective that we may consider to be an insider's perspective that promotes deep understanding and full immersion (100% of the scenarios), which, in turn, reinforces the subjectivity of the experience and promotes the development of personal emotions.

Our study allows us to take stock of an initial dichotomy (which also emerges in the educational scenarios created) between IVEs as "settings" or as "media" for learning. This aspect is interesting because IVEs come under the category of eco-training, where they are used in classroom situations or contexts and constitute learning resources. In a nutshell, IVEs are used in our dataset mainly as a new type of audio-visual support wherein semiotic elements encourage discovery rather than real simulation. This finding may be due to the fact that a majority of students chose to work with 360° videos without VR helmets rather than other types of more immersive applications requiring helmets and glasses. However, while IVEs allow rich contextualization of learning, their use remains under-exploited in the scenarios. The contextual elements are sometimes perceived as mere "scenery". In the majority of scenarios, they serve as a support for an activity where interactions take place mainly in the classroom in a blended-learning task. More rarely are they used as an instrument to communicate in the target language (interacting with strangers via avatars in Sansar).

Do IVEs lead to a renewal of classroom practices?

The different utilization schemes as exposed by the learners emerge from the following criteria:

- IVEs support *freedom of learning* (as with all open, authentic, raw resources) as opposed to classroom IVEs which require more or less closed guidance. The question of who controls navigation/exploration also differs in the proposed scenarios, however self-regulation strategies and evaluation practices do not appear in any scenario.

- IVEs support *interactivity*. Interactivity can be functional (moving in the 360 video) or intentional (moving to respond to a treasure hunt). Interactivity may or may not be combined with collaborative work. There may be either a dynamic relationship (learning context) or a static relationship (setting) shared with the IVE. This sheds light on how IVE environments are "instrumentalized".

- The *role of learners* in an IVE is varied. Learners may thus act as "extractors", who locate, search for elements proposed by the scenarios, as "transformers", who reuse elements worked on or discovered or as "gardeners", who collect, gather and cultivate elements for future use. The three-tier typology proposed by CHANIER (1998) for learning in open environments may thus successfully be applied here. It allows us to better conceptualize how an IVE is "instrumentalized and instrumented" (RABARDEL, 1995) by the scenarios.

The present study leads to a reflection on the potential of IVEs and their exploitation by pre- and in-service teachers. Every teacher-participant found it easy to integrate IVEs into the curriculum which is rather positive. Nevertheless, there is a problem with the "French" approach to language learning in middle and high schools, wherein the teaching of grammar and vocabulary dictates the teaching of the language and wherein the competencies that contribute to real learning of the language are seemingly ignored. In our opinion, IVEs would make a judicious contribution to teaching pragmatic and sociolinguistic aspects of the language. Furthermore, cultural aspects which are at the heart of the teaching-learning of a language and announced by pedagogical scenarios may not always be targeted during the teaching process.

IVEs seem to encourage other methodological and pedagogical approaches by focusing on embodiment and emotions over the approaches generally generated by textbooks. Through the sensory experience that they generate, the IVEs propose to "feel" in the target language, thus following in the footsteps of unconventional language learning methods such as suggestopedia created by Lozanov in 1966 (LOZANOV & GATEVA, 1988) or theatre practices (ADEN, 2013). However, if we look at the lesson sequences in which IVEs are integrated, the bulk of the lesson is carried out traditionally, with IVEs being utilized to reinforce or prepare the learning outcomes that are worked on with the teacher. IVEs are used as stimuli to engage in language learning rather than as simulating authentic communication situations. Thus, feedback from the teacher or other participants is insufficiently taken into account by the scenarios, which does not allow for the development of the self-regulation skills that are important for immersive learning. Many scenarios fail to address two essential points that are linked to learning a language autonomously: (1) there is a lack of sufficient guidance when using IVEs, or (2) there is excessive guidance which "dries up" the range of IVEs (i.e. IVE affordances are not utilized). The value of IVEs stems from stimulating learner engagement to support L2 interactions. In order to do this, IVEs need to be decision-making spaces that encourage learners to take initiative. Tutorials aimed at accompanying more

autonomous learning practices might be more relevant to prepare learners to informal learning processes in immersion.

CONCLUSION

In conclusion, we can understand why virtual reality and IVEs are seen to be an asset in the teacher's pedagogical toolbox: learners are placed in realistic communicative situations and have the chance to live extraordinary experiences. As simulated experience, VR increases learners' cognitive, emotional and physical engagements and offers language learners a safe space to practice their skills (DALGARNO & LEE, 2010). In spite of the various limitations to the use of VR in education (CHATEAU *et al*., 2019), IVEs act as speech catalysts and stimulate written/oral expression and emotions. They prove to be good devices to develop and practise linguistic, cultural, socio-linguistic and pragmatic skills.
Our literature review demonstrates that multiple studies have dealt with the feasibility of integrating IVEs into educational contexts. However, baring a few exceptions (such as the very recent study by CHEN & KENT, 2020), research focusing on the perception and use of IVEs by learners is still more or less limited to the "wow" effect or infatuation with a novel piece of technology.

The present paper has sought to question the use of this new technology and to better understand the extent to which IVEs (as immersive artifacts) could become "instruments" for supporting and mediating language learning. The IVEs selected and the scenarios proposed by the participant-teachers of our study offer situations that mimic reality (simulating a visit to a city, for example) with frequent emphasis laid on the creative and emotional dimensions of the situations. Although IVEs facilitate the integration of real-life situations in the classroom, future teachers also prefer to solicit the "hedonomic" (HANCOCK *et al.,* 2005) dimension of IVEs, while responding all the same to their main concern of making language learning motivating enough for teenagers.

Our results suggest that the immersive nature of IVEs (a) sustain learners' attention and engage them in complex linguistic or cultural tasks, (b) help in developing cultural and linguistic skills, and (c) enhance procedural language learning in a realistic context. Through the sensory experiences that they generate, IVEs help learners "feel present" in the target language. By offering an engaging experience, IVEs offer a new way of appropriating complex topics of discussion (such as immigration or ethical issues of technology) as well as the "strangeness" of a foreign language. They are perceived as a means to reduce anxiety and promote collaboration and mutual aid in the classroom, fundamental issues with teenage

audiences. Finally, inciting didactic reflection on the integration of IVEs in language learning does not only imply technological preparation, it also requires preparing teachers to better understand how immersion enables the acquisition of an L2. Instead of enforcing interaction from learners situated in a simple classroom environment, we contend that it be more beneficial to *integrate* immersion in the language classroom, which would, furthermore, aid in harnessing the true potential of multimodal resources.

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APPENDIX 1. Participant profile

Scenario	Individual or Pair work?	Gender	Age	Language taught	Level taught
1	Individual	female	22	Spanish	Mid- school
2	Individual	male	21	English	High school
3	Pair work	female	24	Spanish	High school
		female	23	Spanish	High school
4	Pair work	male	23	Spanish	High school
		male	24	Spanish	Mid-school
5	Pair work	male	26	English	High school
		female	21	English	Mid-school
6	Pair work	male	25	Spanish	Mid- school
		female	44	Spanish	Mid-school
7	Pair work	female	25	Spanish	High school
		female	22	Spanish	Mid-school
8	Individual	female	31	English	Mid-school
9	Pair work	male	46	English	Mid-school
		male	25	English	High school
10	Pair work	female	21	English	High school
		female	20	English	High school
11	Individual	female	25	Spanish	Mid- school
Total	**18 participants**	**11 females**	**avg age = 26**	**10 Spanish teachers**	**9 teach middle schools**
		7 males		**8 English teachers**	**9 teach high schools**

APPENDIX 2. Multi-criteria grid

Meta data	Identity of the participants
Learning situation	Target language
	Level of the learners (CEFR)
	School level, age of the pupils
	Thematic integration in the school curriculum - Title of the unit - General objective - Skills developed
	Type of IVE

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Characteristics of the IVE chosen	Tool used
	Design elements and affordances of the IVE - Immersion - Interactivity - Presence - Engagement
Characteristics of the educational scenario designed	Emic/ etic perspective
	Role of the learner - language learner - language user
	Learning goals - skills - learning content
	Nature of the activity - type of activity - collaboration - guidance - feedback - evaluation

APPENDIX 3 - List of the IVEs that the pre and in-service teachers used for their scenarios

Warao Indians. Delta of the Orenoque, Venezuela. 360 Video 4K:
https://www.youtube.com/watch?v=52gfcbnL6NU

Moros i Cristians Alferes Moro 360: https://www.youtube.com/watch?v=-LR3eRdVtnU

New York City 8K - VR 360 Drive: https://www.youtube.com/watch?v=2Lq86MKesG4

Visita virtual 360, Mezquita Catedral de Cordoba: http://visitavirtual360.com/mezquita-catedral-de-cordoba/

Feria de Abril de Sevilla en 360º :
https://www.youtube.com/watch?v=gjaQk11O3Uk&feature=share

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New York City 8K - VR 360 Drive: https://www.youtube.com/watch?v=2Lq86MKesG4

New York City 360° Experience | Escape Now:
https://www.youtube.com/watch?v=0qtdheM1cGw&t=1s

4K 360° Christmas in NYC: https://www.youtube.com/watch?v=yopqNTdX9FY&t=150s

En peligro de deportación (VR/360):
https://www.youtube.com/watch?v=GJ4TlWRv_PM&feature=share&fbclid=IwAR0VmMZA
jD3tBmWu6qTtsJPxh_qbpdMmDPx2INoYHbpIERPzFXgmjM4JWlg