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The Embodiment Dimension while Learning and Teaching in a Virtual World

Martine GADILLE

Institute of Labor Economics and Industrial Sociology (LEST), Aix-Marseille University
Aix-en-Provence, 13626, France

Maria Antonietta IMPEDOVO

Institute of Learning, Teaching, Assessment and Training (ADEF), Aix-Marseille University
Marseille, 13006, France

ABSTRACT

The paper focuses on the features of embodiment configurations when using the virtual world in the classroom. The context is a secondary school (students aged 11-15) adopting an educational immersive 3D virtual world. We conducted participant observation, collecting video-audio records supported by a student focus group and teachers' interviews. The analytical framework of this paper draws on the iterative interaction of the complex arrangement of bodies and objects in physical and virtual settings. Our results highlight the dynamic ways in which the arrangement of bodies and material acted as a mediational means between real and virtual settings.

Keywords: Embodiment, Space, Virtual World, Secondary School, Avatars, Learning.

1. INTRODUCTION

Virtual World (VW) is an active field in full evolution. Adopting and integrating this VW into the classroom requires the teacher to design teaching sessions that change traditional modalities. Sessions with VW must mobilize the curriculum content with the teacher's creativity. In this paper, the use of the VW focuses more on incorporation – absorption and transportation – than on immersion. Players are productively bound to these virtual environments via social and cultural codes that are designed into the game; these codes are also acquired through the remediation practices of everyday life by the player. The metaphor of incorporation allows us to avoid such a dichotomous relationship: it expresses the phenomenon of immersion or presence as an assimilation into the consciousness of the game world in a manner that is coextensive with our being in the physical world. This does not imply that the two are equal, but rather that the physical and the virtual are both aspects of what we perceive as real. Thus, the body becomes present in both the physical world and cyberspace: the interface adapts to the body and the body adapts to the interface. Taking into consideration the widespread distribution of this specific technology, the aim of this paper is to analyze the implications of body configurations in sense-making in a physical and virtual learning context. In the next section, we will briefly discuss our conceptualization of embodiment for the present investigation. Then we will describe the context, methods and findings of a case study involving interdisciplinary learning in a French secondary school. Finally, we discuss the findings and draw conclusions.

2. EMBODIMENT BETWEEN THE PHYSICAL AND VIRTUAL

The concept of embodiment has gained currency in recent years, particularly in the light of new forms of interaction and engagement with technology. Situated learning is deeply rooted in bodily activity. This perspective offers rich reflections for conceptualizing the relationship between the physical actions of the body and meaning-making processes [1] [2].

Embodied interaction claims that any action is constituted by a complex arrangement of multiple semiotic fields (e.g., gestures, the body, language, surrounding objects and images) that are deployed simultaneously and influence each other. C. Goodwin [3] writes that the notion of embodiment encompasses orientation, gesture, and intonation, among other physical aspects of interaction. The moment-to-moment arrangement of these various semiotic fields is called contextual configuration. This contextual configuration changes during the course of action: new semiotic fields can be brought in and old ones treated as irrelevant, adapting with the new proposals.

With VW, the body becomes the main interface of interaction, manipulating the information available. Incorporation into the VW is an experience of involving cognition, emotion, and imagery into a narrative [4]. In such systems, media interface development achieve through the collaboration between a start-up, teachers and researchers, is aimed at providing users with fully immersive experiences, with the ultimate goal of making the virtual experience natural and pleasant. In these systems, the body plays a central role by becoming progressively embodied in the learning process. Therefore, it is challenging to determine how the body and materiality enter into contextual configurations and gain their significance in relation to the physical and virtual setting, a special spatial and temporal configuration of current reality.

3. DISCURSIVE MEDIATION OF THE REAL IN A VIRTUAL CONTEXT

The virtual environment is a communicative context in which the user enters a reconstructed environment and interacts with the environment and interlocutors. The term "interaction" indicates the complex construction of meaning that human beings perform when acting in a space, be it simulated or not. In this article, we examine how the participant makes sense of their environment and learning activity through their body, discursively negotiated in a space-time dimension.

Virtually mediated reality through an avatars relationship in virtual worlds (VW) introduces a state of immersion based on being, to occupy space and time, the here and now, in a virtual present separate from the physical space.

VW in a context of educational virtual worlds is an outcome of a continuous process of social construction engaged in by participants, who embody meaning in the spaces and artefacts around them, according to the activity of the moment [6]. Learning activities engage participants, which mobilize both physical and symbolic spaces and resources.

4. RESEARCH QUESTION

As stated above, we focus on the configurations of the interactions between embodiment and materiality as well as the characteristics that emerge within a mixed physical and virtual learning context and how they are discursively negotiated. To reach this aim, we analyze teachers and students involved in a physical classroom and online learning activity mediated by the design and uses of an educational virtual world. The research question is: How do embodiment and materiality configurations come to reality in a specific space-time learning setting mediated by the virtual world?

5. METHODS

Context: Virtual World in a French Secondary School

This study is embedded in an extended project that takes place in a secondary school (between 11-14 years old) in south-eastern France. This school is part of a technological experiment in line with the Digital Plan for Education launched by the French government in May 2015. In 2016, the school joined the "Connected Schools" digital experiment, which supports and finances the use of digital tablets in the classroom. The main aims of the institutional project are 1) to propose a scientific study of the technological and social conditions of appropriation of an educational VW; 2) to support, within the territory of the regional education authority via a collaborative network, the sharing of knowledge resulting from the joint work of researchers and teachers; and 3) to create a training guide for trainers or teachers wishing to get involved in this field. Participatory and collaborative processes are developed between teachers, the researchers and ITC staff of a startup, and institutional partners through continuous spirals of planning, action, observation, reflection and re-planning [7]. The aim is to sustain the development of teachers' professionalism in a context of students' new expectations and heterogeneity, through achieving a critical change of their digital literacy by using the potentialities of the VW.

The project adopted proprietary and purpose-designed educational software based on Open simulator technology similar to that of Second Life. After entering the virtual space via their avatars, participants meet and interact with one another and with 3D objects in real time. At the beginning of the project, all the teachers and students involved in the VW attended an initial one-hour training session, where they learned some basic notions of the human-machine interface. At the end of the session, all participants were already able to manipulate the avatar (to walk, jump, fly, dress) and the environment (to find a landmark, search the inventory, etc.). Almost all the students already had experience with video games, with different levels of expertise. This is not surprising considering that over 91% of children over

the age of two play video games and are therefore familiar with them and are probably accustomed to their structure [4].

The educational VW is adopted by the teachers on the base of three main immersive pedagogical projects, co-developed with the ITC support and research team:

- 1) The "Interdisciplinary" project is a 3D scriptwriting of lessons combining English, Italian, French, history, mathematics, and technology. It is dedicated to 5th-year classes with the main aim to build 3D objects and give meaning to them within the framework of a tailored scenario;
- 2) The "Language and International" project focuses on linguistic exchanges between the French school and an Italian secondary school. Their respective avatars explain to the others the meaning of a virtual exhibition prepared beforehand and show photos of their favorite places in their city;
- 3) The "Homework done" project helps small groups of students, who face difficulties with the subjects, to benefit from remote homework support provided by a school teacher. The students are connected in VR using their avatar from their home environment during the afternoon.

Data Collection and Corpus of Data

A systematic collection of data concerning the three pedagogical scenarios described above started in September 2018. Regular visits to the school are made by the research team, supporting a dialogue of trust and familiarity with students and teachers. All the data are anonymous and the children's families have given their authorization for video recording.

Data collection consists of ethnographic observations (with note-taking and photos), full video recordings of classroom lessons (50 minutes), automatic recording of log data and virtual activities, including chat discussion. Specifically, we focus on a dataset consisting in five video recordings of teaching lessons (of about 45 minutes), one teacher interview (37.41 minutes) and a focus group with students (37.09 minutes). The five teaching sessions consist of:

- Four sessions in the classroom with the use of VW concerning math, French, English and Italian, taking part in the Interdisciplinary and Language projects. The classroom is composed of 20-22 students (about 11-13 years old). All of them are very familiar with the VW.
- One VW session in math from the "Homework done" project. The session involved 3-4 students (10-11 years old) guided by a teacher. The students involved in this little group have some difficulties with the subject and require extra support. They have limited experience of this secondary school VW due to the scarcity of in-classroom use by other teachers. They only know some spaces explored with the mathematics teacher. Table 1 shows a summary of the data selected.

Table 1: Nature of the data collected

Didactic project	Subject	Teacher	Class	Data
Interdisciplinary (teacher and students in classroom and VR)	Math	Mathy	5C - 22 studs.	VR and classroom audio-video recording; Teacher interview; Students focus group
	French	Ketty	5D- 22 studs.	VR and classroom audio-video recording; Teacher interview
Language and International (teacher and students in classroom and VR)	English	Carmen	5D- 22 studs.	VR and classroom audio-video recording;
	Italian	Alice	7 studs.	VR audio-video recording
Homework done (students at home; teacher and students in VW)	Math	Sally	4 studs.	VR audio-video recording

Data Analysis

Our main data were the audio-video recordings; the other data sources were used to clarify and enrich our interpretation of the students' and teachers' activities. The main data were catalogued [8] and organized in a coding grid. The analytical framework of our study draws on iterative interaction analysis frameworks with a focus on embodied interaction.

We started by reviewing each video recording session closely to understand its structure and interactional ordering from the participants' perspectives. For this, we repeated our searches in the data to find relevant clips based on the criteria above. We selected topical episodes [9] [13] to carry out a more detailed embodied interaction analysis, which was transcribed and qualitatively analyzed.

6. RESULTS

Negotiation of physical and virtual body boundaries

With regard to this dimension, we find continuous references to the physical and virtual setting, both contributing to what we perceive as real. Teacher stress over behavior in the VW can be discussed online or in the classroom, in continuity between the two dimensions. The potentiality of the VW is to allow the subject to enter an extra dimension of the self, bringing with them a personal story and the knowledge of their own social and cultural area to be shared with others. What is interesting indeed is this double physical and virtual immersion in a single space-time of the physical and virtual class.

For example, in his math session, Mathy, the teacher, uses the VW to explore different geometric shapes. The goal of the sessions is to respond to the problem by constructing a cube in the VW. Mathy uses his avatar to manipulate the cube in virtual space (Figure 1a). The students are confronted at the same time and space with the consistency of the teacher's body and avatar in front of them. The transition between the use of VW and the overhead projector to facilitate explanation is continuous. Thus,

there is a constant interruption of the flow of observations. Some student-avatars are lost and cannot reach the teacher in the same VW space. Mathy starts to search for them and transport them thanks to his avatar. He successively brings all the students' avatars close to him to assemble them in the same space, reproducing the context of the social presence of the classroom in the VW. The teacher searches for those that are still missing and finally finds his avatar surrounded by the student-avatars (Figure 1b), who jump on him.

Figure 1: Math teacher explaining volume building in the VW



The virtual is no longer experienced as an experience in itself, because it is based on the frame of social meanings in which each individual is able to place it. It is in this sense that the VW can be considered experiential, in which the perceptual component (visual, tactile, kinesthetic) merges with interactivity. The VW thus conceived becomes a communicative tool which acts not only among users but also between them and the environment in which they are immersed. It enables imaginary building through situated learning.

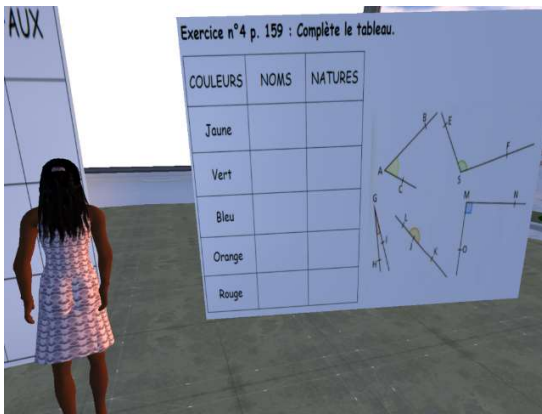
In sum, the boundaries between the physical and virtual body are negotiated to make sense of the activity. The avatars are considered an extension of the body, at the same time they are both discursively negotiated powers (go through another avatar; enter in the body of others) and represents limits and responsibilities (to be lost and need help; not to jump on the teachers; not to push colleagues; to avoid punishment with good behavior).

Multimodality in action

In sum, with this second dimension of "Multimodality in action: disruption and recall" we would like to stress how communication between users takes place through the continuous negotiation of meanings that the actors bring out in their interactions with the virtual environment.

In one example to illustrate this dimension, the math teacher is connected with four students from their homes. The aim of the session is to recall the previous lesson about angles and to help the students complete some exercises. In the space, there are some panels with exercises to do and the four avatars explore them. The teacher invites them to read the panels. Some students zoom on it without moving their avatar. Others, as shown in Figure 2, move their avatar to come close to the panel without zooming, reproducing a common physical behavior – to move closer to see better. It must be noticed that all the students have been trained to use the zoom application.

Figure 2: Lilly moves close to the panel

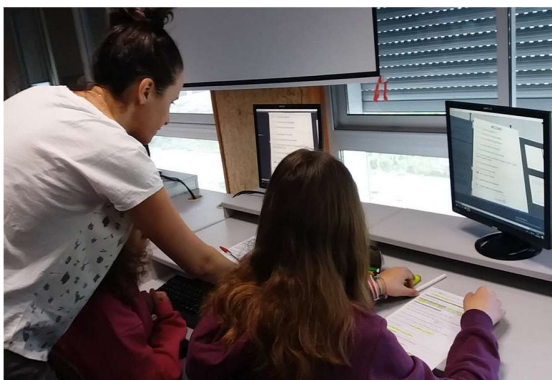


The teacher's instructions are distributed between the online panel, the sheet of paper given in the classroom, her body and the avatars. The instructions given have a spatial connotation with reference to the avatar body, strictly referred in a real physical dimension. At the same time, the teacher's avatar comes closer to the student's avatar to talk to her when she meets difficulties to solve the problem. The interaction goes on in a continuous interaction between the physical and virtual dimension (avatar body and personal body; online space and virtual space).

Exploration to build meaning

In the educational field, one of the opportunities of VW is represented by the possibility to enable the subject to actively participate in the creation and development of their own knowledge. In the example in Figure 3, the English teacher, Carmen, and two students are trying to understand a technical problem. One student, considering there are some problems to see the panel with the English instructions, has called the teacher. Through searching together they quickly find an autonomous solution to outline the technical problem. The teacher is surprised by the creativity of the students to implement autonomous strategies with respect to her modality and prescription. The students mobilize the resources around them to achieve their goal, demonstrating their commitment to the task and the building of meaning during their action.

Figure 3: Help of the teacher in a mixed reality



To place the participants in an active situation of narrative, social and sensory immersion [10] it is important that the interface becomes transparent and the controls implemented by the user are fluid [11] in relation to the network infrastructure and

characteristics of the equipment. This requirement for fluidity in the usage of technology has led teachers and their supervision to develop skills of negotiation with local authorities to obtain equipment and network infrastructure with sufficient high-speed Internet access within a policy context that fosters the autonomy of educational establishments and accountability for the management of technology. The instructional design [12] of educative virtual worlds involves both a renewed organization at school and an agency with relevant and more diversified actors of the educational territory.

7. DISCUSSION AND CONCLUSIONS

In this article, we discuss implications of the students' and teachers' embodied configuration for sense-making between the physical and virtual world in the context of learning activities in a secondary school. Our results highlight the dynamic ways in which the arrangement of body and material act as a mediational means in a physical and virtual setting. In sum, we explored how, in reality, sense-making is interconnected with the physical and virtual body of the participants, negotiated discursively. This study was born of a participative observation of the students' and teachers' interactions, making it difficult to grasp the richness of the data. The pedagogical scripts analyzed are reformulated by the teachers, trying to better adopt the willingness of the students, along with the didactical prescription, oriented to a more collaborative task in the classroom and in the VW.

From the proposed analysis, we can consider that the use of a virtual space in the classroom can introduce new opportunities for teachers who desire instructional changes through authentic tasks involving 3D object manipulation, creativity and corporal mobility. In this secondary school, the uses of both avatars and artefacts in a virtual environment is aligned with the collective transformation of teachers' professionalism through changes in how the learner acquires, applies and constructs knowledge.

Finally, we can consider that the introduction of a VW at school allows a questioning of the training project and the operating methods of the school through informal learning in elective activities where adolescents forge their character. However, even if it is the object in the traditional architectural space of school, rituals to discipline, monitor, and control the student's body are not a central element in the academic and didactical concerns for learning. Yet it is through the body that emotional engagement occurs in the interaction, allowing people to be affected and hence enacted by what they experience. In this soft gamification of learning, the exploration of embodiment gives space to discover new processes of meaning-making. In such a context, the use of virtual worlds as a medium for learning new knowledge and skills [14] emerges as an original research track by highlighting, both in class or out of class, the manipulation of a second (virtual) body, that of the avatar, invested by the subject. Nevertheless, in a future work, for a better performativity of the VW, we must explore the concept about wayfinding. With this concept, it can be possible reduce the desorientation of avatars in VW.

On another point, most research on the virtual worlds of education has focused on student learning without the organizational and institutional conditions of their use. This situation leads to the neglect of the creation of meaning, which lies at the heart of the systems of representations and beliefs that underpin teachers' professional identities. These dimensions of change are at stake to transfer this experiment in others schools. To achieve a larger use of educational VW, the main pitfalls are not the creativity and capacity of teachers to organize the techno-

pedagogy through a community of practice. The limits to appropriate the VW are mainly the way according which the centralized institutional framework in which their tasks are embedded, does not take into account the time that must be spent to radically innovate and experiment new technologies.

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