3D E-Learning for Collaboration

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Abstract:

E-Learning with conventional 2D learning management systems (LMS) displays some fundamental weaknesses in supporting collaborative learning, for example due to the excessively text-based communication.To make a quantum leap in improving collaborative E-Learning, you need to shift from 2D to 3D. Unfortunately collaboration, collaborative learning and the fundamental reason underlying this need have not been well understood until now. We clarify these notions and the role that space plays in learning. We show how these insights enable us to make a proper design for a 3D Virtual Learning System, as exemplified by the QUBE system, which allows us to learn, teach and work collaboratively as if the group were face-to-face, although nobody is present in a physical room yet all are interacting online from anywhere.

Keywords: *Collaborative Learning, 3D Virtual Learning System, 3D Virtual Learning Environment, spatial clues, QUBE.*

1. Introduction

Collaboration and knowledge sharing are becoming more and more important for learning in our rapidly evolving Knowledge Society, but E-Learning with conventional 2D LMS (Learning Management Systems, like Moodle) displays some fundamental weaknesses in supporting them for the benefit of learning. One weakness is the absence of interaction; student teams which try to collaborate online by means of 2D LMS are often disappointed and shift to meeting in person or other conventional ways of collaborating. But although they offer better collaboration opportunities, even onsite learning and blended learning suffer from some relevant limitations: first of all the limitations related to infrastructural resources (like rooms, tables, whiteboards, posters, etc.) because they cannot easily be modified (quantity, location); then, if we consider that they require travelling to the teaching location and back home (which is becoming more and more time and energy consuming) two additional limitations appear: less time flexibility (fitting collaborative events into the busy schedules of a group) and less ecological sustainability (pollution and waste of fuel energy due to travelling many km multiplied by the number of participants travelling).

How to empower collaborative learning and at the same time overcome these limitations? We suggest that a carefully designed 3D Virtual Learning System (people, processes & technology) could provide the right solution to this problem.

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2. Collaboration

In a world that changes faster than we can learn (see Obeng 1997, p 6), collaboration is becoming more and more relevant as a way of working and learning. But what does “collaboration” in fact mean, perhaps the same as “cooperation”? The two terms “collaboration” and “cooperation” are often defined as if they were synonyms, but practice and the longstanding scientific debate about their distinction suggest that they mean two different things. *Cooperative* interactions are accomplished by a division of labour among participants in which the task is split into pieces and each person is responsible for one piece (see Roschelle & Teasley, 1995, p 70); in *collaboration*, instead, task and responsibility remain a unit and as a consequence, dealing with shared knowledge plays an essential role: during collaboration, individuals are *“mutually engaged in a conscious, continuous effort to construct and maintain an underlying shared knowledge structure as a basis for accomplishing their task.”* (Bettoni et al. 2016, p 159). But if dealing with knowledge plays such a relevant role in collaboration, then learning must be seen as an essential part of collaboration; thus first of all we suggest taking a closer look at involved knowledge processes (like setting knowledge goals, acquiring, developing, preserving, sharing, evaluating knowledge and making it transparent) at the very places where learning occurs; and secondly, as regards people, considering a good team spirit and a positive sense of community as critical success factors of collaboration.

3. Collaborative Learning

If we need more collaboration in our society, and if knowledge cannot be simply transferred from teachers to students but requires students to be personally engaged, then we also need more collaborative learning (CL). But CL does not just happen because two or more students come together and interact. Experience shows that designing and implementing successful CL can be a challenging task. Why? We see three main reasons: the first is that CL requires a very high level of awareness *how knowledge processes work*, that we do not have yet (there are many knowledge theories, but they all have serious problems). Consequently our conceptions of CL are unsatisfactory and our CL designs are, in many cases, built on weak foundations (second and third reason).

What can we do to facilitate effective and efficient CL? First of all, we should become more *humble and critical* in terms of our conceptions of knowing and knowledge: Ernst von Glasersfeld’s Radical Constructivism (1995) can help in this regard, by replacing the notion of ‘truth’ with the notion of ‘viability’. Secondly it would help greatly to clarify what we mean by “CL”. From our understanding of collaboration (section 2), it follows that CL needs at least two essential elements: A) accomplishing a single task together (for example problem solving) and B) being mutually engaged in performing collaboratively knowledge processes. In activity (A) the focus is on "single task" and "together": everyone works on a shared task, like in the collaborative string game. In activity (B) the important thing is the shared knowledge structure, a learning outcome generated by knowledge processes performed collaboratively. Last but not least, we could try to link learning and doing (work) more tightly as has been done in the project-oriented didactics developed by E. Obeng (www.pentaclethevbs.com). This didactics has three essential components: 1) a system model of things to be done (project elements + relations); 2) resources (called PETs) for doing what must be done; and 3) collaborative learning (see Barkley at al. 2014) in space. Now, what about the role of space in collaborative learning?

4. Space and Learning

In existing “flat” learning platforms only experienced educators use the communication tools, in all the other cases (the majority) interaction is rather absent, and this is of course a big problem for collaboration. One reason for this absence of interaction is that users *cannot interact in their usual way*; moreover the course-centered approach discourages learners from organsing their tasks and even prevents cooperation with other users, learners or educa-tors (see Kotsilieris & Dimopoulou 2013, p 151). On the other side there is evidence that interaction becomes much more intense and collaboration easier in 3D platforms: why? Could it be that space itself contributes to these improvements? Yes, it is. Space in fact plays a fundamental role in cognition. Kant explains this at the beginning of his theory of mental activity: *“Space is a necessary a priori mental construct, which underlies all outer perceptions (Anschauungen)”* (Kant 1787, p 38) and knowing, he adds later on, always requires a combination of perception and conception (ibd. B 74). Thus space will be contained in any knowledge item and consequently also in any human thought. Evidence for this view can be found also in many examples taken from modern science and from daily life. In an interview from 1916, Albert Einstein told Max Wertheimer that he thought in images and feelings and very rarely in words (see Wertheimer 1959, p 213-228). In a letter to J. Hadamard he wrote that the elements of his thought were *“of visual and some of muscular type”* (Hadamard 1945, p 142-143). A part of the motor system, socalled mirror neurons, are involved in understanding the actions and intentions of others (see Ferrari & Rizzolatti 2014). In the method of loci, a mnemonic method (known from Ancient Roman rethoric), each item to be remembered is placed in space along an imaginary route, at familiar locations. Last but not least, visual metaphors and figurative language are widely used in communication to facilitate the understanding of abstract ideas. If space is so ubiquitous in human thought, then in online situations in which people need to interact (learning, working), we could make these interactions more efficient and effective by providing spatial clues. This requires people and learning activities which use spaces and movements as well as a threedimensional technology, for example a desktopbased 3D Virtual Learning Environment providing places, buildings, rooms, background objects, fixed and portable objects (whiteboards, tables, etc.), audio and video communication and avatars able to navigate the environment and come together.

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5. System Design

Now we are ready for the design of a 3D Virtual Learning System. According to the aforementioned Pentacle didactics, we distinguish three basic elements in our system: learning, doing and technology. The three basic design principles are: first the *learning* element has to be designed as a collaborative activity with people interacting in space; secondly the *doing* element consists of real work scenarios as goals towards which the learning has to be oriented; and finally the virtual environment (the *technology* element) must provide spatial functionalities which enable both the learning and the doing.

6. Example of a System: QUBE

QUBE is a commercially available example of a 3D VLS that implements the 3 aforementioned design principles. It is essential to take seriously the fact that here “system” refers to the unity of three constitutive elements: learning, doing and technology. With software alone, without the other two elements, the system is empty and useless: like a violin when you do not know how to play it. A typical session on QUBE begins with welcoming the participants as they arrive in the course space represented by an individual avatar, a simple box figure (like LEGO minifigures, but genderneutral) which provides enough of a human form to foster the needed identification. Using your avatar, you are able to communicate with other people just as you would in the real world. You can move around in the rooms of a building, physically interact and work shoulder to shoulder, literally, brainstorming with many other people by means of whiteboards and sticky notes. The facilitators welcome each one individually and make sure that they are ready to start. Then the avatars can visit the lecture room until the lesson starts. The room has been carefully prepared in advance: the task tools (called PETs - Performance Enhancing Tools -, which are guidelines, procedures, about how to accomplish a task; each PET is described in terms of *“what is it”*, *“why do I need it?”, “when do I use it?”* and *“how do I use it?”*), boards, tables and chairs needed during the lesson have been placed on the walls and on the floor. The lesson starts with an icebreaker (for example writing your name on a card and placing it on a world map to indicate your current geographical position) and continues with an introductory collaborative activity, for example “Hopes & Fears”: thinking about the current session - what are your expectations and what are you afraid of? Each participant writes his/her contributions on cards and places them on the hopes or fears board. A facilitator supports this group work by ordering the cards in clusters and clarifying their meaning. Then the class starts working on the learning task itself, which on QUBE is always an authentic, meaningful kind of task, for example a real problem to be solved. PETs like “FIX IT NOW” or “5 Ps” help to clarify the problem in the beginning. PET “FIX IT NOW” is a way of avoiding risks for real and PET “5 Ps” is a way of making sure that messages which you have tried to get across are received and acted upon. Some specific question will arise and provide opportunities for starting group work.

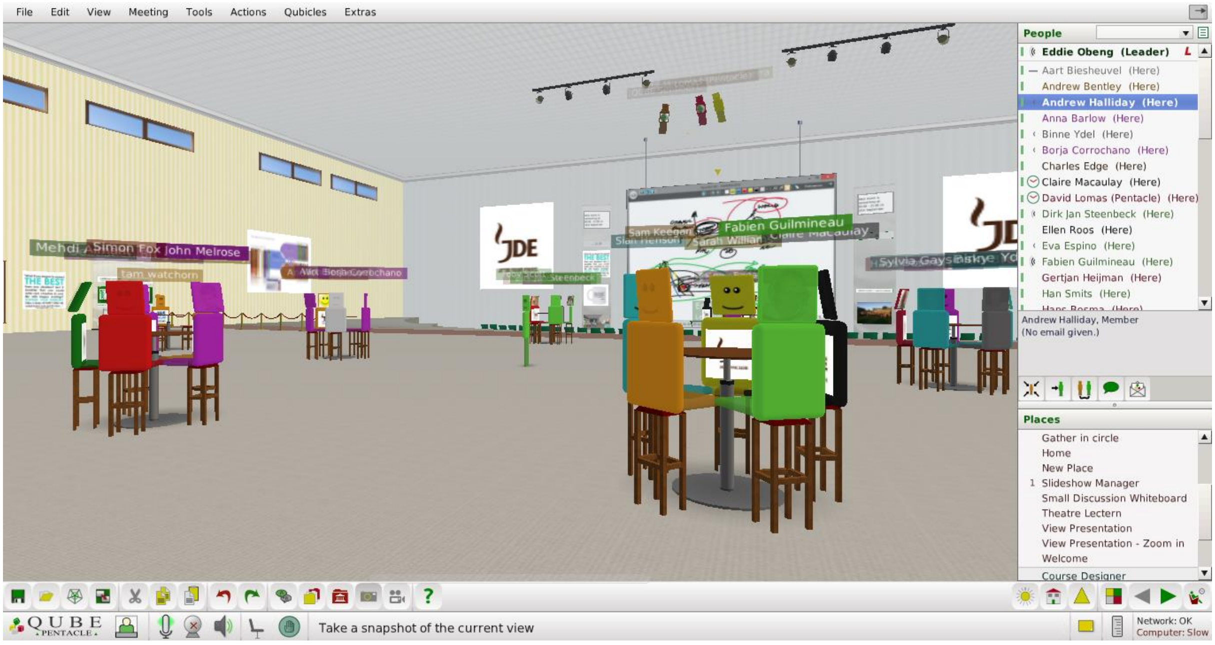

Figure 1: Groups at tables on QUBE (http://www.pentacle.co.uk/)

Groups are formed and small groups can sit down on chairs at round tables in the same room. Larger groups can gather in front of a huge whiteboard, with sections separated by panels. At tables and within panels, the group members will only hear each other, without noise from other groups (a feature that is quite impossible in a real room). Shortly before the time assigned for the group work has elapsed, a signal (flashing room light) lets the groups know that soon they will have to return to the plenary assembly, usually gathering in a circle in the middle of the room. Here a socalled spincasting will be performed: each participant in turn will be given the opportunity to give brief feedback about the group work (insight, remarks, questions, etc.). This sequence of interactions in three steps (plenary with a PET, group work, plenary feed-back) could also be applied in the following phases of the lesson. Finally a PET called RAPID will help the class or the individual groups to define the next steps and re-lated tasks to be accomplished when and by whom after the lesson.

7. Conclusions

We have outlined the foundations for the design of a 3D Virtual Learning System which can em-power collaborative learning and at the same time overcome limitations in infrastructure, flex-ibility and sustainability. *First comes* a knowledge-oriented understanding of collaboration; *secondly*, based on this, we will be able to take seriously the essential role of knowledge pro-cesses for CL; as a consequence, we *thirdly* suggest a project-oriented didactics for courses which closely link learning and doing; *finally*, since space plays a fundamental role in cogni-tion, we need to make sure that people and learning activities use spaces and movements in a 3D Virtual Learning Environment, like for instance QUBE.

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