Exploring the Micro, Meso and Macro
Proceedings of the European Distance and E-Learning Network 2018 Annual Conference
Genova, 17-20 June, 2018
ISBN 978-615-5511-23-3
ISSN: 2707-2819
doi: https://doi.org/10.38069/edenconf-2018-ac-0022

ONLINE GROUP LEARNING IS DEEPLY GROUNDED IN SHARED KNOWLEDGE AND SPACE

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Introduction

Group learning via a 2D platform (e.g. Moodle or similar) has long been part of daily learning practice. Unfortunately, this solution leads to *text-based* or rather *text-heavy* interactions: you need to be able to write well and better still, enjoy *interacting by writing* and not every student does. Moreover, text-based interactions are good for inquiry tasks, but they are ineffective and inefficient for problem-solving tasks. In fact, experience has shown that the interaction required for collaboration is lacking or inefficient, especially in cases where the main task, like in projects, consists of collaborative problem solving. Therefore, it is not surprising that students use 2D platforms solely as a storage space for documents, quite never for collaboration. There is a lack of online team interaction (Bettoni, 2003) and the question is why. We think that flat platforms do not meet the requirements of rich collaborative interactions online. So, which are these requirements and how can we better support online group learning to fulfil them? For answering these questions, we propose 3 steps: first, clarifying what we mean by *collaboration* (and its relationship with knowledge), secondly developing a deeper view of the role of space in the process of knowing and thirdly a better understanding of the true potential of 3D platforms.

Related Work

Ten years ago, it was unclear which enhancements were needed to make a 3D collaborative virtual environment a good platform for serious online collaboration (Bainbridge, 2007). Surprisingly, this is still the case today. 3D virtual spaces are still in their early phase of development and little research exists about their use in learning and working (Vartiainen, 2015; p.142). By examining the methodological and theoretical choices of empirical studies on 3D virtual environments (3D VE) and focusing on social and group phenomena (Sivunen & Hakonen, 2011), the authors were able to identify four major trends. First, attempts to demonstrate the applicability of real-life, social behaviour norms in 3D VEs. Second, a lack of work group studies using 3D VEs. Third, the micro-level treatment of social phenomena and groups at the expense of broader phenomena like leadership. And fourth, a lack of covering theory relating to group processes in 3D VEs. In fact, most research performed on 3D VEs has been game-based and few empirical studies have been published on their professional usage (Bosch-Sijtsema & Sivunen, 2013). Despite this lack of research, 3D VEs provide several very interesting opportunities for learning and working groups (Bosch-Sijtsema & Sivunen, 2013). For this reason, it would be interesting to continue a strand of research that was started about

ten years ago during the Second Life hype but was abandoned after the decline of Second Life (Schmeil & Eppler, 2008; Eppler & Schmeil, 2010). It developed a systematic description and classification of collaboration patterns (group interaction scripts) in 3D collaborative environments. By providing reusable patterns that leverage the ample possibilities only 3D virtual environments offer, this research sought to help facilitate and enhance team collaboration and collaborative learning.

Collaboration is Based on Shared Knowledge

As a starting point for clarifying the term collaboration, we suggest distinguishing it from the term cooperation. Practitioners often use the two terms synonymously but experience shows that they are not synonyms. Sometimes definitions explain the difference through the degree of *alignment* in working together ("Collaboration is very similar to, but more closely aligned than, cooperation", Wikipedia). But this also does not bring more clarity; it just introduces the new question of what *closely aligned* means. Cooperation can be defined by considering that working together is 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). The main success factors of cooperation then are subject matter competence of the individuals involved to ensure that they deliver a high level of quality. Collaboration is different: the task remains as a single unit; each participant works on it and is responsible for it as a whole. He or she cannot pull out because then the task as a whole will be jeopardised. Moreover, 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; based on Roschelle & Teasley, 1995). The task is always accomplished by all participants; and more importantly: since they work on it as a single task unit, also knowledge should be a unit: precisely that knowledge unit that is needed to do and associated with the task unit. To obtain this, the participants have to share their knowledge and this sharing of knowledge becomes all the more important. The main aim here is to build up a knowledge resource or knowledge structure that is common to all participants in the collaboration.

Presence Model of Knowledge Sharing

Now the question is how to implement knowledge sharing and specifically the sharing of tacit knowledge (Kharabsheh et al., 2016) in an online group learning situation, which is collaborative in the sense that we have defined. The model that we suggest here assumes that a successful knowledge sharing experience occurs through the integration of three essential elements: cognitive presence, social presence and leading presence (see Figure 1). This approach is inspired by the Community of Inquiry (CoI) framework, a process model of the collaborative construction of knowledge in a community of learners (Swan, Garrison, & Richardson, 2009). *Cognitive presence* is defined as the extent to which participants of the collaboration succeed in constructing and sharing knowledge (meaning) through sustained interaction and reflection. *Social presence* is defined as the extent to which participants of the collaboration succeed in projecting their personal characteristics onto the group (team, community), thereby presenting

ISBN 978-615-5511-23-3

themselves to the other participants as "real people". Finally, *leading presence* is defined as the design, facilitation and support of cognitive and social presence (of the related processes) for achieving personally meaningful and organisationally worthwhile collaborative outcomes.

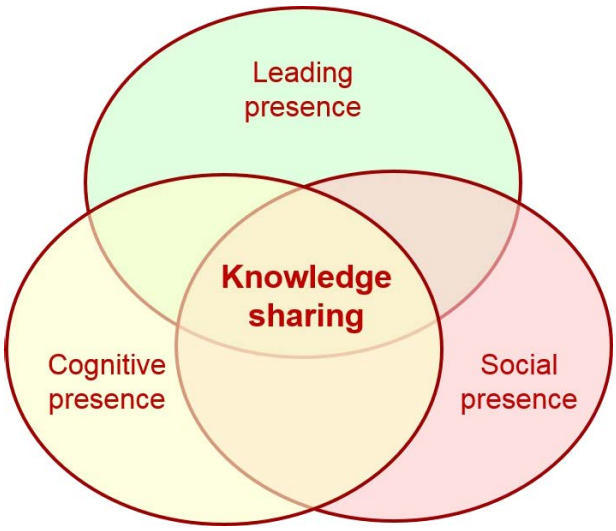

Figure 1. Presence model of knowledge sharing (adapted from Garrison et al. 2009).

Realizing and integrating these three kinds of presence in an online setting, requires six groups of e-skills:

1. Co-constructing knowledge online: (a) shared language, (b) shared content / storage, (c) co-planning, (d) co-solving, (e) co-writing.
2. Negotiating meaning online: (a) reification, (b) participation.
3. Projecting oneself into an online group: (a) expressing emotions, (b) open communication (mutual awareness, recognition), (c) group cohesion (empathy, participation).
4. Managing online collaboration: coordinating, organizing, designing, planning and assessing the collaboration.
5. Supporting cognitive and social online presence: (a) giving feedback, (b) fostering reflection, (c) balancing cognitive and social presence.
6. Facilitating online interaction.

Sharing Knowledge is Deeply Grounded in Space

Space, in the context of this paper, means simply "the three-dimensional extent in which objects and events have relative position and direction" (Encyclopedia Britannica, 2004). In existing "flat" platforms, only experienced users are able to effectively and efficiently use the available communication and collaboration tools; in all the other cases (the majority), interaction is rather absent, and this is of course a big problem for online collaboration. One reason for this absence of interaction is that, on flat 2D platforms, users cannot interact in their usual, *natural* way. Fortunately, in the last 10-15 years, continuous advances in computer technology have led to the availability of sophisticated platforms that support the replication on screen of three-

ISBN 978-615-5511-23-3

dimensional physical spaces, movable objects, movements, navigation and communication between digital representations of humans (Schmeil & Eppler, 2008). On these 3D platforms there is evidence that interaction becomes much more intense and collaboration easier (Burton et al., 2010; Burton & Martin, 2017): why? Could it be that space itself contributes to these improvements? But how? Following our "presence model of knowledge sharing", we try to answer this question by splitting it into the three more specific questions, one for each of the three elements of the model.

Cognitive Presence

First, which is the role of space in *cognitive presence*? At the beginning of his theory of mental activity, Kant explains: "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 (ibid. B 74). Thus space will be contained in any knowledge item and consequently also in any human thought. Many examples taken from modern science and from daily life also provide evidence for this view. In an interview from 1916, Albert Einstein tells Max Wertheimer that he thinks in images and feelings and very rarely in words (see Wertheimer, 1959; pp.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; pp.142-143). A part of the motor system, so-called mirror neurons are involved in understanding the actions and intentions of others (Ferrari & Rizzolatti ,2014). In the method of loci, a mnemonic method (known from Ancient Roman rhetoric), each item to be remembered is placed in space along an imaginary route, at familiar locations. Moreover, visual metaphors and figurative language are widely used in communication to facilitate the understanding of abstract ideas. Finally, if knowing is inseparable from activity and context (situated cognition) then the related knowledge "is stored not in the form of answers, but in bit and pieces of the experience we have accumulated" (Dixon, 2013). Hence, a subsequent question or problem will be answered or solved by pulling together suitable bits and pieces, thus constructing knowledge in the moment and in a way which will also be situated in (influenced by) space, time and experience (de Michelis, 2016).

Social Presence

Second, what is the role of space in *social presence*? A first component of social presence is the ability and confidence *to express emotions* like closeness, warmth, attraction. Other examples of emotional expression that contribute to social presence in a group are humour and self-disclosure (Garrison et al., 2000). Humour, in particular, decreases social distance and can as a result act as an invitation to start a conversation. A second component of social presence is *open communication*, like for example mutual awareness, which tacitly indicates interpersonal support, acceptance of the other, encouragement and based on these type of expression, contributes to building group cohesiveness. Recognition is another example of open communication, achieved by explicitly expressing appreciation and agreement as well as complimenting and encouraging others. Finally, group cohesion is also an indicator of social presence. It appears in activities that build participation and empathy, thus helping participants

ISBN 978-615-5511-23-3

to see themselves as part of a group, not only as individuals. These three components of social presence are all related to space in the sense of "what connects and separates" (de Michelis, 2016) the persons involved. Thus, space appears to be essential as the medium that enables social presence. If space is so ubiquitous both in cognitive and social experience, then in online situations where people need to interact (learning, working), we could make collaboration more efficient and effective by providing spatial clues. This requires an appropriate design of the collaboration event (meeting) which makes sure that people and activities use spaces and movements. It also requires a suitable three-dimensional technology, for example a desktop-based 3D Virtual 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.

Leading Presence

This is how we come to the third question: what is the role of space in *leading presence*? A first component of leading presence is *collaboration management* which is concerned with coordinating activities, organizing group events, encouraging participation, assessing the needs of the group and the success of the collaboration, designing and maintaining the online environment. A second component of leading presence is *facilitation*. The leader tries to be neutral and not to use the decision-making authority accorded by the formal position. His/her main task is "to help the group increase its effectiveness by improving its process and structure" (Schwarz, 2005), like in group facilitation. Finally, a third element of leading presence is *support* in reflecting on the state of cognitive and social presence, providing feedback and helping the group in balancing the other two kinds of presence in order to achieve the planned objectives. When a leader designs a new collaborative online session, he or she must define *what* the next step in the problem-solving process will be (a matter of methodology), *why* this step is important (a matter of value) and *how* participant will actually perform the step. This is where space comes in: the leader has to determine *how* participants will *interact in space* so that both cognitive and social presence will be suitably supported and the work will be accomplished effectively and efficiently. This includes determining, for instance, arrangements of space (which rooms, which board and which panels positioned where on the walls or in the room), which movements in the rooms would be useful and when to undertake them, how to distribute the *boundary objects* of the interaction, etc.

The QUBE System

QUBE is a commercially available example of a 3D system that is suitable for supporting collaboration events, which are consistent with our presence model of knowledge sharing. The QUBE system is composed of three basic elements: learning, doing and technology. Accordingly, there are three basic design principles of QUBE. 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 collaboration has to be oriented (like in project-based learning); and finally the virtual environment (the *technology* element) must provide *spatial* functionalities which enable both the learning and the doing. It

ISBN 978-615-5511-23-3

is essential to take seriously the fact that here *system* refers to the unity of the three constitutive elements of learning, doing and 3D 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, for instance a meeting, begins with a session facilitator welcoming the participants as they arrive in the space. Each person in QUBE is represented by an individual avatar, a simple box figure (like LEGO mini figures, but gender-neutral) 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 other people by means of whiteboards and sticky notes. The facilitator welcomes each one individually and makes sure that they are ready to start. Then the avatars can visit the collaboration space room until the meeting starts. The room has been carefully prepared in advance before the first meeting and will remain available in future. Boards, tables and chairs needed during the meeting are available on the walls and on the floor. Tools called PETs (Performance Enhancing Tools) are guidelines or procedures about how to accomplish a task and can easily be replicated on a whiteboard or panel when needed; each PET is linked with a specific documentation which describes "what is it?", "why do I need it?", "when do I use it?" and "how do I use it?".

Regularly scheduled problem-solving and decision meetings with a project team are the most important requirement for collaboration effectiveness and efficiency (Gordon, 1977). On QUBE these meetings, called *drumbeats*, eventually receive the high consideration that they deserve. During a meeting participants can split into subgroups and move to an area in the same room provided with chairs and round tables and sit down here when they want to discuss something, for example how to proceed when dealing with the specific question they have selected to work on (cognitive presence, leading presence). Once they have decided this, they can move to another area of the space and gather in front of a huge whiteboard, with sections separated by panels. At tables and within panels, the subgroup members will only hear each other talking, without noise from other subgroups (a feature that is quite impossible in a real room). Shortly before the time assigned for the work in subgroups has elapsed, a signal (flashing room light) lets the groups know that soon they will have to return to the plenary group, usually gathering in a circle in the middle of the room. Here the group performs a so-called spin-casting (social presence): each team member in turn has the opportunity to give brief feedback about the work carried out in the small groups (insight, remarks, questions, learnings, etc.). This sequence of interactions in three steps (plenary with a PET, work in subgroups with various PETs, plenary feedback by gathering in a circle) can also be applied during any phase of the collaboration. At the end of the meeting, a PET called RAPID will help the whole team to define the next steps and related tasks and plan when and who will accomplish them after the meeting (leading presence, social presence).

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Conclusion

In collaborative learning, all students work on the same, single task that remains a unit instead of being split into pieces, like in cooperation. Thus the knowledge required for accomplishing the task must also become a unit and for this, students need to mutually engage in a conscious, continuous effort to construct and maintain a shared knowledge structure suitable for the task. This is not easy to do, especially for tacit knowledge, among other things, because of the essential role that presence plays in collaboration as we have defined it. According to our *presence model of knowledge sharing*, the integration of three essential elements is required: cognitive presence, social presence and leading presence. In each of these types of presence, space has a great influence: it is contained in any knowledge item (cognitive presence), is essential as a medium enabling social experience and needs to be taken into consideration when designing how participants will interact (leading presence). As a consequence, in online situations where students need to interact (group learning), we could make the learning more efficient and effective by supporting it with a system which provides spatial functionalities and interaction methods which are consistent with our presence model of knowledge sharing. The system that we have presented, QUBE by Pentacle (UK), fulfils these requirements thanks to an appropriate design of its three basic elements: learning, doing and 3D technology.

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