How Can 3d Virtual Worlds Be Used To Support Collaborative Learning? An Analysis Of Cases From The Literature

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Abstract

Excited at the prospects of engaging their Net Generation students, educators worldwide are attempting to exploit the affordances of three-dimensional (3D) virtual worlds such as Second Life, citing "collaborative learning" as rationale, though often without careful consideration of the design of learning activities to support and enable collaboration. Drawing on three recent examples of 3D virtual worlds in education, the primary aim of this article is to critically assess the evidence that well-designed learning interventions using these types of environments are able to exhibit the key ingredients or elements of collaborative learning. The article concludes with a consideration of some of the problems and challenges that exist, before offering number of recommendations for practitioners.

1 Introduction

3D games, simulations and virtual worlds have captured the attention and interest of educators worldwide, who are devoting large amounts of time, financial and other resources into research and development aimed at harnessing the pedagogic potential of these technologies. The 2007 Horizon Report (New Media Consortium, 2007) identified virtual worlds and massively-multiplayer online games (MMOGs) as emerging areas that were likely to impact higher education within two to three years and four to five years, respectively. Nevertheless, it can be argued that the continued development of and investment in 3D virtual environments for educational purposes should be considered contingent on further investigation into the validity of assumptions that these environments provide inherent advantages over their non-3D counterparts (Dalgarno, Lee, 2009).

The focus of the present article is on the extent and ways in which 3D virtual worlds can be used to facilitate collaborative learning, beginning with a review of collaborative learning and its basic elements. Later, the author takes a critical look at uses of virtual worlds in education that specify "collaborative learning" as rationale, and analyses three exemplary cases from the rapidly expanding body of literature in this area.

2 Defining collaborative learning and its key elements

Collaborative learning (CL), sometimes also referred to as cooperative learning, may be defined as a student-centred approach in which groups of individuals work jointly on a well-defined learning task. According to Smith and MacGregor (1992), CL is an umbrella term for a variety of instructional techniques including problem-centred instruction, writing groups and learning communities; however, Cuseo (1992) operationally defines CL in terms of six procedural elements that distinguish it from other types of small-group learning:

1. Intentional group formation: The criteria used for deciding the composition of groups is predetermined and designed based on the learning objectives and/or the characteristics of students in the cohort.
2. Continuity of group interaction: CL groups sustain their discussion and interactions over a substantial or extended period of time, so as to allow for continuity and to create sufficient opportunities for building rapport and social cohesion.
3. Interdependence amongst group members: This involves creating the perception of group members that they are linked in a way that one cannot succeed unless everyone succeeds.

4. Individual accountability: Members are accountable for their own performance as well as that of the group overall.
5. Explicit attention to the development of social skills: Instructors must take deliberate steps to foster social competencies, e.g. through explicit instruction on effective skills for communicating and relating to others or the provision of opportunities for students to reflect on and evaluate the social interaction process.
6. Instructor as facilitator: The role of the instructor is one of an expert peer or coach, who offers advice, encouragement and clarification while promoting reflective dialogue and critical thinking through the issuing of timely and relevant questions.

3 Affordances of 3D virtual worlds for collaborative learning

Salomon (1993) advocates analysing information and communication technologies (ICTs) from the perspective of their educational affordances, which, according to Kirschner (2002), can be defined as the relationships between the properties of an educational intervention and the characteristics of the learner that enable certain kinds of learning to take place. In what ways do the affordances of 3D virtual environments lend themselves to the goal of enabling and supporting collaborative learning? Chris Dede (1995) of Harvard University was one of the first researchers to discuss the possibility of combining the capabilities of virtual environments with the capabilities of synchronous Computer Mediated Communication (CMC) tools to support collaborative learning. According to Anderson (2004, p. 42), "the greatest affordance of the Web for educational use is the profound and multifaceted increase in communication and interaction capability", which is even more evident in Web3D – Today's multi-user, distributed 3D environments, including MMOGs and virtual worlds, allow geographically dispersed users to explore an environment concurrently, with each represented by a surrogate persona or "avatar" visible to other users, and with tools allowing text-based or audio communication. More importantly, these environments allow two or more users to jointly and synchronously undertake kinaesthetic or tactile activities within the game or world.

In addition to providing facilities for verbal communication, virtual worlds allow users to align non-verbal elements with their written and/or spoken words. They provide distinct communicative advantages over text-based CMC and groupware tools that do not capture facial expressions and body language and that are therefore limited in terms of their ability to convey feelings and emotions. Indeed, the types of avatar–avatar interaction enabled by 3D virtual worlds can be considered to be richer than those that

are possible with many 2D alternatives, since users can motion directions or point out virtual objects to others in three dimensions, and use the positioning and orientation of their avatars as reference points when referring to objects involved in shared activities.

Thus, many authors and researchers have written about how immersion in 3D environments offers considerable potential to support collaborative learning, if combined with suitable instructional strategies. For example, collaborative role-play strategies can be adopted with the aim of encouraging learners to "lose themselves" in the willing suspension of disbelief as they adopt their role and identify with their avatars (Dickey, 2005). In addition, Antonacci and Modress (2008) discuss the pedagogical benefits of allowing students to collaboratively build and interact with their own simulated worlds and the objects therein. Such user-created virtual worlds can promote the types of creativity and generativity that are characteristic of the Web 2.0 movement (Boulos *et al*, 2007).

Unfortunately, however, it appears that many educators tend to leave collaborative learning to chance, assuming that students will simply begin to work collaboratively and productively by virtue of the fact that they are placed together in a multi-user 3D virtual world with rich communicative capabilities. They often fail to recognise the need to explicitly and thoroughly engage with the concept of CL and the elements that so define it when designing learning tasks and activities. In the next section, the author reviews a number of novel applications of 3D virtual worlds, and examines them through the lens of the six key, defining elements of collaborative learning outlined in the previous section.

4 Examples of how 3D virtual worlds are being used to support collaborative learning

Table 1 showcases a number of innovative projects/cases involving the use of 3D virtual worlds as platforms for collaborative learning, drawn from the exemplary practices of educators from institutions around the globe. They were identified as a result of an extensive literature search, which yielded a large number of studies and case reports citing "collaboration" or "collaborative learning" as an objective or rationale, but of which many lack clear evidence of the key elements of CL as identified earlier. The three exemplars presented are analysed in terms of the degree to which they support collaborative learning, using the aforementioned framework proposed by Cuseo (1992).

TABLE 1
Three Examples of Collaborative Learning in 3D Virtual Worlds

Reference		
Di Blas, Paolini and Poggi (2003)	Mennecke, Hassall and Triplett (2008)	Jarmon, Traphagan and Mayrath (2008)
Education sector		
Secondary education	Tertiary education (university)	Tertiary education (university)
Institution/organisation		
Politecnico di Milano, Italy and the Israel Museum	Iowa State University, USA	University of Texas at Austin, USA
Description of teaching/learning activity		
Students aged 12–19 from around the world meet in a purpose-built 3D virtual world to engage in cross-cultural exchange while learning about the Dead Sea Scrolls and the 2,000 year-old culture that produced them.	Second Life and its economy are used as a platform for teaching strategic and managerial issues related to e-commerce and entrepreneurship in an MBA course.	Students in a graduate interdisciplinary communication course work together and in collaboration with architecture students at the same university to create a virtual presence of two green, sustainable, urban housing designs in Second Life that are later built in a low-income neighbourhood.
Evidence of Cuseo's (1992) six procedural elements of CL		
1. Intentional group formation		
Four classes of students from different geographical areas engaged in similar courses/levels of study are selected to participate, with the aim of ensuring openness and rich cross-cultural interaction.	The group formation processes are not clearly specified in the paper.	The communication students form an interdisciplinary team, with the aim of encouraging them to practise mental flexibility in approaching problems from a multi-perspectival outlook, and to hone their abilities to work with diverse audiences.

2. Continuity of group interaction		
The activity consists of four one hour-long sessions, spaced over approximately two months in order to give students sufficient time between each session to reflect on their experiences and prepare for the next meeting.	Students undertake a chain of learning activities over six weeks, including a scavenger hunt, a series of SL guest speaker presentations and a final project requiring them to prepare a report for a local non-profit organisation interested in the potential of SL to facilitate their outreach and awareness initiative.	The project-based learning experience extends throughout the duration of the course, i.e. one entire semester.
3. Inter-dependence amongst group members		
During each session, the students work in teams to prove their abilities in two "cultural games", comprising a multiple-choice quiz and either a treasure hunt or a "matching-pairs" game, both taking place in a virtual labyrinth. The games call for frequent and meaningful interaction amongst participants; if team members do not exchange information and assist each other, they have little chance of emerging victorious.	In the scavenger hunt activity, students co-experience and explore the virtual world as they embark on a mission to discover interesting places and practise basic SL skills. To complete the exercise, they must retrieve the relevant instructions, decipher the embedded hints and teleport to the location of the item they are searching for. The exercise requires students to work in teams, communicating and coordinating their activities and collaborating in the process.	In order to successfully complete the course assignments and projects, the students have to interact extensively with educational and non-academic participants both in real life and in SL. Interdependency is evident in that the communication students require the domain knowledge and expertise of the architects, and vice-versa.
4. Individual accountability		
Every student must complete a number of assigned readings in preparation for each session. Moreover, prior to the start of the cultural games for each session, a member from each team performs an ability-game to win for his/her team the right to answer first.	Each student is required to write a personal, reflective essay answering several questions that probe into their experiences during the scavenger hunt.	Students are required to diarise their observations and experiences in their own personal "worldview journals", which are assessed at end of the semester.

5. Explicit attention to the development of social skills		
This element is not given detailed coverage in the paper, although the building of team spirit and inter-school rapport are listed as strengths of the project. An allusion is also made to how the remote students are encouraged to socialise in the first session.	This element does not appear to be given explicit treatment in the paper.	One of the main course objectives involves the development and application of high-level communication skills, although it is unclear from the paper what explicit strategies were used to develop these skills.
6. Instructor as facilitator		
The activity is facilitated by a Guide from the Israel Museum. At the start of each session, the Guide welcomes the students and leads them around, introducing a number of new key concepts and revising the material they should have studied before the session. He encourages the students to articulate their own thoughts and reflections, stimulating discussion and the asking of questions. To conclude each session, the Guide conducts a debriefing and previews the next session.	The instructor and support staff develop the course content and build the SL-based infrastructure to support the students within the virtual environment. Support and scaffolding are additionally made available through the provision of various instructor-generated objects and structures, the coding of scripts, and the positioning of instructions at strategic locations around the SL island. The instructor also facilitates classroom and group activities within the virtual educational facility developed specifically for this purpose, and furnishes guidelines and instructions for the scavenger hunt and the final project.	The instructor provides guidance and scaffolding to the students throughout the semester. For example, the students take "field trips" in SL that are facilitated by the instructor. They are also provided with live, instructor-led training sessions and online tutorials to cover basic SL skills.

5 Discussion: problems/challenges and recommendations for educators

The exemplars discussed in the previous section present signs of optimism that well-designed learning interventions using virtual world environments can manifest the key ingredients or elements of collaborative learning. However, the use of 3D environments for teaching and learning in general, and collaborative learning in particular, is not without its problems and pitfalls. For example, in certain instances, the features and intricacies of a 3D environment or world may work to the educator's disadvantage, distracting or discouraging students from attending to the key conceptual tasks in a collaborative learning activity (Jacobson *et al*, 2008). The need for navigation, exploration and object manipulation, and to use a particular type of user interface and/or hardware device to perform these tasks, may also impose an additional cognitive load on the learner (see for example, Dalgarno, Harper, 2004; Chen, Wan, 2008).

Hence, it is vitally important that educators carefully consider whether the use of a 3D virtual environment is required or ideal for a given collaborative learning scenario, by weighing up the relative advantages and disadvantages of such an environment against those of the available alternatives. While Table 1 depicts promising examples of how educators are able to apply pedagogically sound and innovative instructional design and teaching practices aimed at facilitating collaborative learning within virtual worlds, there is still a paucity of research investigating how the unique features and characteristics of virtual worlds can be used to bring about specific benefits for CL that go beyond the motivational aspects (McLellan, 2004). As there are still many unanswered questions, educators must be wary of making assumptions or "common sense" deductions based on intuition or extrapolation of anecdotal observations. For example, virtual worlds and other 3D multi-user environments are increasingly being used as platforms for collaborative role-play, but this is often done under the presupposition that such activities will be more engaging due to the greater fidelity and sense of presence afforded. Along with this goes the assumption that gesture and non-verbal communication within a multi-user 3D virtual world, game or other environment will lead to deeper and richer communication, and therefore more effective collaboration. These and other claims, although intuitively reasonable, are largely unsubstantiated, yet frequently form the basis of educators' and educational technologists' pedagogical and instructional design decisions (Dalgarno, Lee, 2009). A systematic, evidence-based approach is needed to validate such claims, and to ascertain what works and what does not.

6 Conclusion

To maximise the chances of successful collaborative learning experiences in virtual worlds, it is recommended that participants are trained well in advance, that the expectations are goals are made clear to them, and that an atmosphere is cultivated where there is clearly a need for peer learning, mutual support and interdependence in the performance of tasks. It is also imperative that the centrality of the instructor playing an active role is not overlooked or underestimated. As a consultant, mentor, partner or associate in the collaborative learning process, the challenge for the instructor is to enable learner self-direction and group autonomy while still supplying the necessary guidance and structure. Shared learning activities that are endogenous to the theme and/or fantasy of the virtual world environment must be properly designed to ensure that the interaction between learners moves beyond mere "chatting" to result in constructive dialogue, joint knowledge production and deep involvement in socio-experiential learning, where participants take a keen interest in one another's learning trajectories. Last but not least, regardless of the medium or mode of delivery, collaborative learning requires educators to recognise that definite steps must be taken to foster social and interpersonal skills such as leadership, trust building, team communication, group decision making / consensus building and conflict management. Time and attention must be devoted to the development of these skills, in much the way that academic skills are developed—a "hit-or-miss" approach is simply not satisfactory.

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