Harnessing and evaluating Open Sim for the implementation of an inquiry-based collaborative learning (IB[C]L) script in Computer Science: Preliminary findings from a case study in Higher Education

Nikolaos Pellas, University of the Aegean

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Abstract

From 2007 and now on, it is a common premise for scholars and educators to use multi-user virtual worlds (VWs) in order to enhance students’ technological literacy with contemporary learning strategies. The corollary of interactivity and social formalization of modeling processes in an open source, server-based (standalone) virtual environment is a unique dimension that allows all users (students and instructor) to design a plethora learning activities in conjunction with the most contemporary pedagogical approaches. Accordingly to these provisions, this study focused on the implementation of a collaborative project-based course in Computer science by taking advantage of the open source virtual world Open Simulator (Open Sim). The current case study seeks to present preliminary findings from collaborative experiences of an effort that thirty-five (35) postgraduate and undergraduate students participated with the hybrid instructional format in order to investigate the value of this effort for learning introductory programming lessons. This effort tries to articulate initial perceptions of students’ assessments based on an inquiry-based collaborative learning (IB[C]L) script that they involved, and secondarily to demonstrate the multisensory-multimodal potential perspectives or educational implications that are being emerged from the exploitation of three-dimensional (3D) technologically-advanced environments.

Keywords: inquiry-based learning scripts, collaboration, cyber entities, Open Simulator

Introduction

Computer Science courses in Higher education have received severe criticism because are based on the utilization of two-dimensional (2D) learning platforms and in oral-based teaching methods. Beyond that hybrid course delivery method is used on these platforms, it is lacking the real time feedback from the instructor to his/her students and thence opportunities are limiting for meaningful or purposeful collaborative activities between distributed users (Berns, Gonzalez-Pardo & Camacho, 2013; Lau & Yuen, 2009; Sun et al., 2008). This procedure has led students to become passive receivers of information and this obviously can be provoked from an overloaded theoretical content that is emerging and it is
impossible to be digested or practically applied in innovative learning environments via a typical computer laboratory.

Many curricula internationally have consistent with the didactic models that are necessary for teaching different fields even for the professional preparation of students who enrolled in Computer Science courses. During this operation and based on the conventional teaching methods, it became a rigorous problem to fill the gap between the theory transaction of the dimension between what the theory defines and what in practice-applied computing programming commands at an introductory-level students understand in project-based procedures and how can this process motivate them to cooperatively learn with others. At the same time the rapid changes in 2D or three-dimensional (3D) systems have provided learning materials and occurred on a global level as the most appropriate for the acquisition of programming commands in learning environments. Two main categories of these environments that currently being used for programming courses are those of 2D [Asynchronous] Learning Management Systems ([A] LMS) (Addison, 2011; Kris et al., 2010) and these 3D (multi-user) of virtual worlds (VWs) (Esteves et al., 2010; Pellas, Peroutseas & Kazanidis, 2013), with the latter category to be the most prominent for various educational processes.

All the above have established a novel dialogue in the Computer Science community on how to enable better the Information, Communication and Technologies (ICT) transactions in order to meet new requirements that modern curricula of the 21st century predominantly require. Innovative learning activities by exploiting sources of the Web 2.0 and mostly those that endorse 3D interactive technology have already appeared in different university-level disciplines and have equally unveiled not only valuable impressions to users, but also conspicuous promises for the future.

For almost seven years, many researchers and scholars (Lee, Wong, & Fung, 2010; Pellas, Peroutseas & Kazanidis, 2013; Roussou et al., 2006; Winn, Windschitl, Fruland, & Lee, 2002) have already used the 3D interactive technology as a theoretical background because its features can be combined adequately with the students’ prior experiences in order to be constructed a truly novel platform for enhancing their technological literacy.

Although, a VW is not always being used for educational purposes per se, but with the proper configuration and (co-)manipulation from the same users by utilizing server-based visual tools or artifacts, it can become a reliable training platform where instructors and students (users) can efficiently utilize for learning with the most eligible instructional formats (online/blended). Similarly noteworthy, the explosive growth of the “blogosphere” and Web 2.0 seems to enunciate the users’ needs or demands and thus VWs are proposed to support learning activities
where students have the opportunity: (a) to develop skills or implementing collaborative scenarios (Franceschi et al., 2008) and (b) to perform in a particular activity as a part of a larger community in which they have to share common goals in a virtual place (McArdle et al., 2004). The social aspects of an online VW can attract cyber entities (avatars), because it does not only offer to its users a longer isolation in front of a computer screen, but it has many characteristics of "persistence" (i.e. a VW that continues to exist, even after a user exits from the world and that user-made changes to its state are-to some extent-permanent).

Nowadays, Open Sim is regularly one of the most popular open source VWs composed with a multi-complex “cyber-sphere” of interactive variables (fidelity, interactivity, autonomy etc.). This VW provides a 3D pre-constructed “eco-system” that endorses a whole mixture of roles, activities, relationships, interactions, and circumstances among users. In this vein can give to each cyber entity adequate conditions for the development of the learning process. Particularly significant is the dynamic dimension of the 3D interactive technology which provides a highly intuitive dimension between human and computer interaction, as it incorporates the features of realistic or roots from an illusionary world.

The affordances and positive effects of various learning processes depicted from the utilization of open source VWs (as descendants of web-based social VWs) according to a growing academic literature body (Brandherm, Ullrich & Prendinger, 2008; Pellas & Kazanidis, 2012; Pellas, Peroutseas & Kazanidis, 2013; Vosinakis & Koutsabasis, 2012) were basically all of these studies corresponded to lecture events and the implementation of innovative socio-cognitive pedagogical frameworks. In a research level it would, therefore be useful for the instructor to select and use a 3D VW that might be easily configurable depending on the users’ needs and interests and on the other hand to support collaborative learning scenarios.

In this situation further studies need to examine more carefully the design decisions (pedagogical strategies and appropriate activities)) that are very useful and should be based on constructive and socially engaged learning activities (Petrakou, 2010). Moreover, it should be explored also a number of factors that can influence collaborative learning in a 3D virtual environment, such as interactivity, fidelity representations in learning environments and media sources that usually offered in 3D VWs (Dalgarno & Lee, 2010).

With inquiry-based [collaborative] learning (IB[C]L) script through exploratory activities by utilizing various multimedia applications, scholars and educators can expect that this approach may contribute to a more constructive and meaningful learning process compared with the traditional teacher-centered. The term of “inquiry” is an educational scientific strategy that is used for different
purposes. The general objective of this teaching strategy is to induce students to explore and amplify a plethora of new phenomena around them by making procedures similar to those executed by a researcher and in this notion team members are engaged more in learning activities (Jang, Reeve & Deci, 2010). The efficiency of this process is associated with the students’ increasing interest or performances in collaborative settings (Kong, Mui Winnie & So, 2010).

Juxtaposing to the above, remarkably little research (Lesko & Hollingworth, 2013) was done not only for the investigation of the service level or interoperability issues of “open-ended” VWs, but also for the functionality and efficiency results that 3D visually-rich worlds can provide for the easier acquisition of knowledge in collaborative settings. In continuation, despite the interest that is a limited in amount of case studies (Berns, Gonzalez-Pablo, & Camacho, 2013; Dohi & Ishizuka, 2010; Rico et al., 2011; Weito, Hui & Mingyuan, 2011) with a small sample to explore innovative and alternative teaching methods or models by utilizing only some of the technological services that Open Sim provides. Thence it is also crucial to observe and present not only the technological requirements of open source VWs, but also the capabilities or future-driven directions in case studies that can lead to new educational dimensions.

Based on these findings, the present research effort was to be exploited Open Sim with the hybrid instructional format where students placed at one in all computers, and installed a client viewer. Approximately, theorizing the nature of the problematic view, it was focused in an effort on whether the frontal teaching and mentoring role of the instructor, in accordance with each person that is represented as an iconic figure (avatar) can effectively learn cooperatively with other peers, in a computer lab and in supplementary online settings. In this respect VWs come to transform educational activities from the way of an instructive approach in a socially collaborative structure where students are working as communities and briefly play or learn together.

In this study it is presented a new approach with a collaborative inquiry-based learning background in order to be better promoting the cohesion between theory and practice in introductory Computer Science courses. The project was focused on the active participation between students for the acquisition in a new knowledge field to learn how co-constructing and programming structures in “artifacts-to-think-with” (assembled 3D primitives with behaviors). The current study did not deal with whether any of each student gains the knowledge of programming in any part of the project, but special attention was given on the evaluation of the students’ collaborative work by utilizing Open Sim as an educational learning platform.

The outline intentions of the present study are as follows: (a) to examine the concept of students’ cooperation and characteristics based on an inquiry-based
learning approach, (b) to propose an IB[C]L script which provides the results of a case study by examining the potential characteristics that Open Sim offers, (c) to discuss the research findings, instructional affordances, and last but not least (d) to summarize not only with the obstacles, but also the educational implications of this procedure.

The main purpose of the present study is to utilize and evaluate an inquiry-based collaborative learning script through a case study which was implemented at an Institute of Technology of Greece in order to investigate the value of a IB[C]L in Computer Science courses.

**Theoretical Underpinnings**

*Inquiry-based learning (IBL) in collaborative settings*

Inquiry-based learning (IBL), generally involves the students’ participation in problem-based activities in which they need to explore new information sources and try to solve particular problems collaboratively (Hover & Horne, 2005). IBL also described as a project-oriented strategy that can be particularly based on constructivist and socio-constructivist theories of learning (Eick & Reed, 2002). IBL can equally be described as a cyclical framework signifying through (Bishop et al., 2004): (i) the formulation of the main problem with a question, (ii) the investigation of a main project, (iii) the creation of a solution or an appropriate response, (iv) the discussion, and (v) the reflection in connection with the results.

Inquiry-based instruction can encourage students’ performances basically in learning tasks, as it can help them to understand the actual problems that may be faced in the realistic condition rather than simply focusing on rote memorization (Kolodner et al., 2003). Previous studies (Minner, Levy, & Century, 2010; Ucar & Trundle, 2011) have also stressed that inquiry-based learning science improved students’ understandings in content knowledge based on scientific process skills and enhanced their ability to transfer the acquired knowledge to new contexts, but mainly by utilizing 2D learning environments. However, Wu and Pedersen (2011) have mentioned that the contextual complexity of scientific inquiry learning in 2D platforms may negatively impact students in learning activities and as a result, learners need an appropriate support such as a scaffolding process to enhance their inquiry learning.

In this occasion it can be eventually provided an alternative collaborative inquiry-based (IB[C]L) script which can be based on team-based processes. A learning process via a macro-script that is proposed in this study is generally a CSCL (Computer-Supported Collaborative Learning) approach aimed to construct collaborative processes and determine the basic sequences of activities among users, by creating roles within groups and limiting the mode of interaction with
other groups (Dillenbourg & Jermann, 2003; Kobbe et al., 2007). The main purpose is to engage students as teams in learning activities, ideally based on their own queries. The learning procedure is organized in a cyclic way where students’ questions may lead to the creation of new ideas or other unique projects. This learning process amplified by the social exploration which opted students to ask questions and discoveries in order to seek new understandings (see Figure 1).

![A proposed IB[C]L strategy](image)

Figure 1: A proposed IB[C]L strategy

The conceptual change of the IB[C]L has a naturally socio-constructivist instructional design framework because in the collaborative work students seek to find new learning materials, use tools or resources produced in inquiry-based activities and share or exchange their experiences with other teammates. Thus, students make a progress by sharing, talking and coordinating their teams. An IB[C]L can also be effective at all learning levels from the weakest to the most qualified. It is remarkable that it’s more conducive than other strategies during the learning process because students’ participation is always in high level and this can empower further the use of innovative learning environments (Kursat-Erbas, Aydogan-Yemmez, 2011). Likewise, it should not rule out the instructor’s guidance and coordination between members that must be provided during the learning procedure (Favier & Van der Schee, 2012; Raes, Schellens, DeWever & Vanderhoven, 2012).

The current study presents an "open" IBL approach (Banchi & Bell, 2008) in collaborative settings. This approach requires from students to take initiatives and ask questions in order to conduct several investigations and communicate with other peers in order to discuss the results. Therefore, a well-organized
pedagogical-didactic organizational framework for students to prepare them for open research is needed where they can be guided to complete a collaborative task or achieve a common purpose.

Open source virtual worlds as candidate learning platforms

As we mentioned above, most recent educational practices in Higher education were primarily based on the oral or written communication forms and (re-)presentations of knowledge in different disciplines. Although, this may answer only in theoretical problems in which the instructor who acted as an “expert” usually delivers on the one side but on the other students cannot recall or take the appropriate feedback from their instructor in real time. The research that may outweigh the drawbacks that observed in previous studies in which are implemented scenarios with the utilization of 2D Asynchronous Learning Systems (A)LMS identified a reality where students couldn’t easily share their experiences mainly in online settings. Below are describing these problems:

- Technical problems (Rivera, McAlister & Rice, 2002) which can create feelings of isolation among students (Contreras-Castillo et al., 2004).
- The lacks of previous online learning experiences that may students have (Piccoli, Ahmad & Ives, 2001).
- Wrong expectations or differences in the instructional background of the student population between course delivery modes may pronounce lower levels of students’ satisfaction (Kleinman & Entin, 2002).

This approach combined with other 2D (A)LMS was being a target of criticism because: (i) the learning materials were not always grounded on students’ understandings and prior experiences from the real world; (ii) the self-directed learning and critical thinking skills weren’t sufficiently cultivated, as students were not involved in educational activities to discover or conquer information collaboratively; (iii) the students did not possess on ICT skills to apply the acquired knowledge of real-world problems which were often not well-established.

The most well-known two-dimensional (2D) learning environments (see [A]LMS or Massive Open Online Courses-MOOCs) many times are being used from universities as “warehousing of knowledge”. Students and instructor shared educational resources on the Web and communicate mainly asynchronously with type-based applications (messages on a specific forum and exchanging e-mails with other group members with students). However, 3D VWs have become in nowadays the most well-established candidate platforms for connecting multidisciplinary
learning virtual communities in which users (instructor and students) can learn collaboratively more ease by utilizing both synchronous and asynchronous communication forms (Pellas & Kazanidis, 2013).

In general an open source VW includes a 3D persistent, online and multi-user virtual environment in which users represented as avatars and can interact with other peers or with visual objects as an entity of the environment and by utilizing tools can enhance the imitation of the natural and social status. The applications related to VWs were previously being developed for more than 20 years. In addition several characteristics of VWs were used for the construction of 3D objects or artifacts based on users’ (co-)presence in a common place to be the most important and in parallel different aspect from other 2D technologies where they communicate through synchronous (VoIP, chat text) or asynchronous (gestures, IM) forms to be as another fundamental issue for the implementation of collaborative activities.

The aforementioned definition encompasses also the description of users’ interaction in a pre-constructed “eco-system” that mimics the real world where all users freely can exploit the technical characteristics of the collaborative knowledge construction. The uniqueness of these characteristics combined with many other features that described in this study are considered as sufficient and may cause to users some valuable experiences captured with realistic experiences and contributed to the success of achieving learning goals (Pellas, 2014).

In recent years the use of open source 3D VWs from the K-12 or Secondary educational community according to a growing literature academic body (Pellas, Peroutseas & Kazanidis, 2013; Rico et al., 2011) have provided several pedagogical and technological affordances. Some of the most fundamental that can reinforce the collaborative learning process in a VW are the following:

i) the (co-) manipulation of the time’s and space’s sense, specifically where students need to practice in a common virtual space, co-create 3D visual prototypes to design easily visually-rich artifacts or simulate users’ behaviors and characteristics of their artifacts;

ii) the visual feedback from the environment and from other avatars that use multiple communication forms (synchronously and asynchronously);

iii) the sense of interactivity between students’ by using artifacts may coexist in simultaneous activities with others driving to a narrative flow of the 3D experience;

iv) the scripting and animating usage of constructive scripts for the creation of 3D functional prototypes;

v) the innovative virtual persistent workflow for educational activities, because VWs aren’t learning platforms per se; thence students should
work in a 3D multi-user environment and everything must be configured at the beginning according to their needs or demands.

In this occasion the transformation of social and open source VWs has offered learning opportunities that can support collaborative learning processes and especially the most famous and widespread diffusion of the CSCL. Although, the CSCL approach is based on the fact that ICT transactions must be able to support and facilitate a group’s dynamic dimension that sometimes cannot be attained through the real life’s interaction (i.e. during face-to-face communication and collaboration between students), and based on this treatment it may also reinforce equally users’ communication in a VW.

The instructor’s guidance is occasionally very important as he/she should encourage each student to think, explore, discover or manage the content in order to solve problem-based learning situations and acquire knowledge. As problems become more complex students’ interactions are also becoming more complex through their participation in a project as well. Although, instructors as mentors and facilitators at the same time should provide the appropriate feedback in order to avoid students the complexity from the initial introduction in a VW that can distract learners but the most effective approach to a problem may lead to a more intense and fruitful learning experience (Pellas, Peroutseas & Kazanidis, 2013).

The open-ended technological infrastructure of Open Simulator

Previous notable studies (Pellas, Peroutseas & Kazanidis, 2013; Rico et al., 2011; Vosinakis & Koutsabasis, 2012) have showed that the contribution from the pedagogical use of open source technologically-advanced learning environments in K-12, Secondary or Higher Education can transform them in valuable platforms for the learning process including all cognitive and psychosocial divisions. VWs can become particularly important in order to reinforce the students’ potential expressions, creativity and interaction among stakeholders in various educational activities. Indeed, an open code VW can maintain a successful participatory process that may lead on better group’s cohesion or cooperation, and may improved as a remarkable and innovative learning platform.

The polymorphic dimensions of Open Sim structural requirements are presenting a visually interactive and multi-sensory environment which is exclusively for users and influence their actions in a positive way with one of the following modes: (i) standalone or (ii) networked. The standalone mode as a single process can handle up the entire simply configured simulation “standalone server-based virtual world” including the communication protocol that is particularly the same as this of Second Life. On the other hand the networked mode has various aspects of the simulation, which are separated and asserted among multiple geographical
areas (grids) where someone can exist on different “virtual” machines. Indeed, the potential scale is being enlarged as the number of users is growing at an exponential rate according to: (a) the overall atmosphere of the class (emotion, motivation, presentation which are linked with the original objectives of the course), (b) the possibility of reaching alternative ways for one or more disciplines, aiming to optimize the student’s learning performance, (c) the use and treatment of primary learning context in order to investigate their own without inhibitions, but with the proper guidance and feedback of the instructor, and (d) the interaction between “digital natives” (students and teacher) at the same time, within virtual environment.

The production of the dynamic dimensions can make the 3D VR and especially VWs not only considered as simple simulations, but as “idioms,” i.e. parts of the educational environment which enable educators and scholars to change the entire educational “status quo.” Pretty remarkable is that every educational institution can use Open Sim as a “canvas” to create secured grids and enhance experimental learning activities. This distinctive characteristic indicates that users are discovering new areas of interest and become practically “seekers of knowledge” and not mere recipients of directives and regulations.

**Previous studies in programming courses of higher education**

During the last 30 years, several doubts were highlighted among scholars and students about the added value of programming courses, mainly in the cognitive research field. However, the teaching of basic programming commands considered being until now as an effective "tool" that can be applied with other scientific fields such as Mathematics, Physics and Logic (Papert, 1980). Also, the acquisition of problem solving skills can be used in other subject areas of the international curricula. This intervention presents a variety of problems since the formulation and use of a programming language includes several commands along with the drafting detail that creates a "cluster" of information and force students (novice programmers) not only to assimilate with an essential piece of knowledge or with the use of basic programming commands, but also to engage them more in technical details (Dudley & Butte, 2009). According to the prior literature, the following problems must be notified:

(a) While previous computing experiences may not be significant for studying Computer Science courses, students’ opportunities to solve problem-based learning situations are still lacking. Dunican (2002) has argued that there is no connection between computing origins with the learning materials offered in the Secondary education and based on logical problem-solving
modules. This may put students in a difficult position when they enrolled in computing courses at university level.

(b) Stamouli, Doyle and Huggard (2004) have stressed to the above point of view and suggested that the paucity of creating students' communities cannot encounter them to participate in computer lessons from the first year of university studies. The same researchers have also mentioned that even when students struggle to comprehend the most basic of programming concepts in the final years of their studies, they don’t actually have the appropriate knowledge background to adequately complete them.

(c) There are revealed some significant concerns from students’ perspectives about the effectiveness and value of learning programming languages based on the phrase “why they should do this course” (Duncan, 2002).

(d) Even though it particularly remains unknown if students can sufficiently manage and solve a solution to a programming command in problem-based terms of a pseudocode, and provide syntactically the correct phrase (Kölling & Rosenberg, 2001).

(e) Miliszewska and Tan (2007) have already identified difficulties encountered to first year programming students, but they have as unfortunately mentioned students who enrolled in computing courses are not expected to have prior programming experience, and thence computing experience is not always a prerequisite for understanding other more complicated. In these dimensions some students may enrolled some computing sessions of Secondary education, but others may not.

Moons and De Backer (2010) have shown that students and teachers who use interactive environments for introductory programming courses and in their experiments have found that the environment can help users to understand programming concepts more easily. While Xinogalos, Satratzemi and Dagdilelis (2006) with the 2D micro world objectKarel have attracted the students’ attention and increased their acquisition level, they suspected that the shift from this environment to a “real” programming language will not be so easy, because the difficulties that may appeared to be the following: (a) in the syntax codes and conceptual change and (b) in the programming environment or the lack of a structure editor.

Previous researchers in the field of ICT in general and in Computer Science in particular have already recognized the crucial role of programming course with electronic environments mainly based on animations and serious game-based environments in VWs (Malliarakis, Satratzemi & Xynogalos, 2012; Pellas, Peroutseas & Kazanidis, 2013; Rico et al., 2011; Saeli, Perrenet, Jochems, Zwaneveld, 2011). By utilizing 3D technologically-advanced environments in
collaborative learning processes, students could better participate in learning activities and may try to overwhelm the above constraints.

The first point of view was successfully amplified in the most well-known programming environment of Alice, an object-based computer-oriented environment that offers a programming integrated development environment (IDE). In this environment users recognized its positive impact and with the “drag and drop” technique they created computer animations by using 3D models and storytelling learning techniques more easily (Kelleher & Pausch, 2007).

In this notion VWs can become effective and valuable learning environments for the students’ professional development (technical skill, affective disposition), collaboration with school systems (logistics of access, allocation of resources), aligned with the targeted content (harnessing students’ creative divergence), and initial learning curves (issues of teacher-to-student ratio) (Rosenbaum, 2008). Garvin, Tagney and Savage (2013) have shown from qualitative findings that Scratch4SL (combination between Scratch and Second Life) can provide learners with a programmable, low-floor, high-ceiling construction tools has been sufficiently supported their construction in a wide range of complex artifacts as part of a constructionist learning experiences.

Regarding the use of social VWs in Computer Science courses Good, Howland and Thackray (2008) have investigated whether the Second Life can be used to create innovative learning processes. In the field of Higher education Esteves, Fonseca, Morgado and Martins (2010) have stressed that the identification of problems was hampering the instructor’s intervention in the social virtual world of Second Life and the detection of solutions for those problems that were found effective to the success in using this environment for teaching/learning computer programming.

Virtual worlds may also be used for teaching computer science. The V-LeaF Project (Rico et al., 2011) is another significant project in which students studied computer programming in an innovative and attractive way through Open Sim. However, it should be highlighted a fundamental parameter of the complexity that every 3D environment governed which should be taken seriously into account from instructors and therefore it is urgent to be organized a teaching plan before the beginning of each course in a VW.

According to the aforementioned academic literature, antecedent efforts didn’t really expose or solve any students’ problems in learning programming commands while all of them described learning circumstances that implemented. Basically in Higher education where students have an average cognitive background in programming skills, it is still emerging the urgent need to be conducted a survey which can promote the algorithmic thinking in 3D innovative learning environments. Moreover, as it was previously shown there are still lacking
some other studies for students of Higher education in which students can collaboratively study with other peers programming commands in hybrid settings. It is particularly seemed that the utilization of open source VWs may have a positive effect on students’ attitudes or views about Computer science courses.

This opinion can strengthen according to Crellin et al. (2010) study in which they presented two case studies that utilized VWs as the most valuable platforms for the acquisition of computer science knowledge. Breakthrough in these aspects, VWs in the last seven years have emerged as candidate platforms for contemporary educational practices by providing “edutainment” (education and entertainment) approaches, socialization and collaborative learning scenarios for spatially (or not) distributed users. According to the above there wasn’t found yet any research not only to present findings from the investigation of the students’ engagement in Computer Science, but basically to identify difficulties or affordances for the implementation of learning programming commands in an inquiry-based collaborative learning (IB[CL]) script held in standalone Open Sim server.

Research Methodology

Purpose and research questions

The purpose of the present study is to utilize and evaluate an inquiry-based collaborative learning script through a case study that was implemented in the computer lab at an Institute of Technology (KIT) of Greece in order to investigate the added value of this activity in Computer Science courses.

In an effort to find benefits of an open source innovative learning environments, the research question (RQ) of this study was focused on: *how Open Sim technological capabilities can enhance the students’ interactions and collaboration in an IB[CL] script?*

Participants

The current study was implemented in the middle of April 2012 in order to investigate the students’ expressions from an inquiry-based collaborative activity. The target-sample was composed of thirty-five (35) students (27 men and 8 women) from the KIT that participated in a case study. They were never experienced with Open Sim, since they had attended to a class, in which the authors had described the beneficial formalization of Open Sim educational uses (Pellas, 2012). Their participation was voluntary and as a result they have registered in pairs for the collaborative activity.
Instruments

After finishing the activity, students answered in 29 (twenty-nine) close-ended questions for the primary impression report, and 3 (three) open-ended about problems, views, perspectives and opportunities that Open Sim server-based standalone mode can offer from the Institute for IB[C]L scripts. Firstly, they answered an anonymous questionnaire on demographics, previous experience with ICT and general issues for Open Sim with a tendency to be involved in collaborative activities and presented their artifacts in project-based sessions related to their explorations and experiments. The online questionnaire was in the Greek language. The questionnaire covered the following topics: (a) previous experiences with ICT, (b) general issues about Open Sim, (c) primary evaluation of the collaborative task, (d) users’ co-presence in the virtual community, (e) the students’ views for the learning process, (f) the students’ opinions about the IB[C]L script.

The research was based on the criteria of a quantitative method with 5 point Likert-type scale close-ended questionnaire (1=strongly disagree to 5=strongly agree) to be chosen due to its solidness and wide use. Quantitative (scale) variables were the answers from the main questionnaire and the qualitative (nominal) where the demographics (“Gender,” “Leveraging ICT transactions” and “Months of using Web 2.0 applications”). Also for a better processing and reliability of our descriptive results we have used the statistical program SPSS (ver. 20) for setting up the aggregate data connection, configuration, and creation of templates.

Procedure

In this phase, the lack of case studies in open source VWs from the literature mainly for the Computer Science courses emerged the importance of the current study that tried to cover this gap. It was designed some project-based activities to students’ assess a collaborative laboratory activity with an IB[C]L script between real (computer lab) and virtual (Open Sim) world in a hybrid instructional format. The aims were as follows:

• To enhance the learning outcomes in programming courses via open source VWs.
• To increase the sense of students’ co-presence in a common virtual place.
• To reinforce the usability of tools (or “artifacts-to-think-with”) that already exists or can be produced by users.
• To provide the quality of a collaborative process for students and from their side to be satisfied with the results of each process.
• To acknowledge the overall pleasure of their learning experience in an innovative platform.
The contextual framework of the inquiry-based learning process is followed the development of the model that De Jong (2006) has proposed. Firstly, it was averred the original idea and the needs of each group analysis as it was setting the main scope and finally a semi-structured virtual grid for action-based learning was conducted. Inasmuch as, it was followed the design of the user interface by navigating in the main server-based grid that was available for learning activities, as heretofore users try to occupy the graphic designing and the development of visual objects in the learning procedure.

The main data were gathered from two sessions, lasted 45 minutes, where students and their instructor have participated. In the 1st session students created avatars and learned basic e-skills for exploring a virtual space (e.g. teleport, communicate via chat text or voice etc.). Perhaps the most beneficial effort was the 2nd session because students separated into seven (7) heterogeneous groups of five (5) students, learning how to create exchangeable visual objects and “artifacts-to-think-with” (i.e. highly threshold programming visual objects where users need first to develop and then to add specific serial sequence commands). All of them were physically located in two different computer labs and collaborated exclusively through Open Sim.

Meanwhile, correspondents used their personal Open Sim accounts and avatars to log in and teleported to a standalone Greek Island (a virtual grid only for educational purposes). There, students met their instructor who guided them to the activity setting workflow. At the first step forward, the instructor was posed the problem and then students had to solve it collaboratively, remaining nearby available to provide the appropriate feedback. In this attempt, the vast majority of users (students and instructor) communicated via voice, text chat and IM (Important Message) in a virtual-shaped classroom.

The instructor made a brief introduction to the topic under study to address their problem (the construction of artifacts with behaviors) and then all students separated into teams to work collaboratively for a specific objective. Another crucial characteristic to be mentioned is that students were not really familiarized with the utilization of Open Sim Scripting Language (OSSL), and the available artifacts (materials or virtual objects and tools for scripting and texturing), but with the guidance of their instructor that they tried to learn. The basic expectation was to find information about the construction of a virtual educational island (grid) and then each team tried to configure collaboratively programmed artifacts and presented their thoughts, opinions or projects to other peers. The featuring inspiration was to be built a grid that can be used in Institute’s lessons (Figure 2).
Results

Demographics

In this study, the evaluation of educational programs undertaken from users of the KIT and brought some particularly intriguing results that Table 1 shows:

Table 1: Socio-demographic characteristics

<table>
<thead>
<tr>
<th>KIT</th>
<th>Mean²</th>
<th>SD</th>
<th>Graduate students (%)</th>
<th>Postgraduate students (%)</th>
<th>Overall (%)</th>
</tr>
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<tr>
<td>N=35</td>
<td>22</td>
<td>2.04</td>
<td>21 (86)</td>
<td>14 (14)</td>
<td>35</td>
</tr>
</tbody>
</table>

Figure 2: The illustration of an IC[B]L script
<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>21.7</td>
<td>2.02</td>
<td>17(80)</td>
<td>10(20)</td>
<td>27(76)</td>
</tr>
<tr>
<td>Female</td>
<td>22.5</td>
<td>2.05</td>
<td>4(50)</td>
<td>4(50)</td>
<td>8(24)</td>
</tr>
</tbody>
</table>

Note: * The mean scores for the ages of the group that enrolled with the hybrid course delivery method.

<table>
<thead>
<tr>
<th>N (%)</th>
<th>Hybrid course delivery method (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Graduate students (%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1. Prior online course experience with LMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. No prior course of this type</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>(30.4)</td>
</tr>
<tr>
<td>1.2. Took previous course of this type</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>(69.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Personality traits from the utilization of virtual worlds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1. Neuroticism</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>(19)</td>
</tr>
<tr>
<td>2.2. Extraversion</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>(18)</td>
</tr>
<tr>
<td>2.3. Openness to Experience</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>(47)</td>
</tr>
<tr>
<td>2.4. Conscientiousness</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>(16)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Web 2.0-based applications that users have an account</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Facebook</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>(40)</td>
</tr>
<tr>
<td>3.2. YouTube</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>(39)</td>
</tr>
</tbody>
</table>
3.3. MySpace

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>4</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(10.5)</td>
<td>(10)</td>
<td>(20)</td>
</tr>
</tbody>
</table>

3.4. War of Warcraft (WoW)

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>8</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(8.4)</td>
<td>(8.5)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

3.5. Other Virtual Worlds (Open Simulator, Active Worlds etc.)

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2.6)</td>
<td>(0.1)</td>
<td>(20)</td>
</tr>
</tbody>
</table>

35 30 5

Data analysis

The first intention of this study was to describe the demographic results from users’ e-profiles. Mainly, 72% of the student population was male, while 28% were female, with an average age of 22 years old (n=35, M_age=24.3, SD=4.32). Indeed, it is also seen that 64% advocates are in the “middle” level of using ICT. Most adult users have previously been used other Web 2.0 applications (like Facebook, Twitter, Wikis etc.) from over 12-36 months (15%). Initially, even before presenting the results it was investigated the possible association between “Gender” and “Months of using Web 2.0 applications.” The findings have shown a statistically significant association between two categorical variables by using the $x^2$ test control (Pearson Chi-Square) [$x^2 = 12.257, df = 3, p = 0.002 <0.05$] (see Table 1).

**Table 1: Chi-Square Test**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>12.257$^a$</td>
<td>3</td>
<td>.000</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>20.378</td>
<td>3</td>
<td>.000</td>
</tr>
<tr>
<td>Linear-by-Linear</td>
<td>6.612</td>
<td>1</td>
<td>.012</td>
</tr>
</tbody>
</table>

| Association N of Valid Cases | 35 |

$^a$ 0 cells (.0%) have expected count less than 5. The minimum expected count is 4.32.

It was worth mentioning to be observed in the third category (i.e. “Months of using Web 2.0 applications” for 6-12 months), because it was chosen by the 63% of male versus 22% of female participants, who previously used for 1-6 months,
something that is more than twice rating. Also, according to the second message of the first table [a. 0 cells (0%)], informed about whether to satisfy the condition of the validity of the $x^2$ test, and it wanted more than 25% of the cells to have values less than 5. Thus, we trust the process of Pearson Chi-Square. From the coefficient correlation "$\gamma$" (Gamma) of the vouchers of qualitative variables ("gender" and "months of using Web 2.0 applications") was positive ($\gamma=0.617$). It seemed to be a fairly “strong” correlation and the level of statistical significance is greater than 0.05, according to Singh (2007) recommendations (Approx. Sig=0.712).

Below, it is described the study findings, and for the reliability analysis of each questionnaire section it was used the Cronbach alpha ("$a$"). In all tables, it has been also compared the Mean indicators (Mean) and Standard Deviation scores (SD) for all quantity variables, with p<0.05, as a statistically significant correlation factor of the analysis. Consequently, Table 2 shows the previous “technological literacy” of students. It depicted that ICT can play a significant role in their communication ($a=0.75$), according to their previous experience with the hybrid course delivery method. It also seemed that some students didn’t yet participate in a distributed collaborative process, and Open Sim was the first platform, while on the other hand they didn’t seem to want to use 2D technologies.

### Table 2: Previous experience with ICT

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you previously attended to any project with a hybrid course delivery method?</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>2.27</td>
<td>1.43</td>
</tr>
<tr>
<td>2. Do you think that the technological literacy in nowadays can encounter any challenges that is presented with 2D (A)LMS?</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>2.83</td>
<td>1.47</td>
</tr>
<tr>
<td>3. Have you ever worked with people who were distributed in other places of the world, but their artificial presence was in the same virtual room with your own?</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>2.98</td>
<td>1.27</td>
</tr>
</tbody>
</table>

From Table 3, it can be pronounced that many correspondents were very satisfied with the GUI (Graphical User Interface) of Open Sim ($a=0.77$), and it’s sure that the Open Sim control panel was not difficult to be configured from the users. The GUI provided the prompt feedback that is primarily needed during the learning process.

### Table 3: General issues about Open Sim

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was your first impression with Open Sim positive?</td>
<td>35</td>
<td>4</td>
<td>5</td>
<td>4.17</td>
<td>1.43</td>
</tr>
<tr>
<td>2. Did the technical requirements of Open Sim respond</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.34</td>
<td>1.47</td>
</tr>
</tbody>
</table>
satisfactorily to your personal computer?
3. Was the GUI met the initial requirements to conduct with educational programs for modeling objects, implement seminars or lecture courses?
4. During the design of virtual activities was your system provided the appropriate feedback to facilitate your interaction with other peers?
5. Was the user’s GUI difficult for controlling your personal elements?

Table 4 (a=0.79) affirmed that many correspondents who used Open Sim tools and communication channels appeared to be quite good. Students were freely allocated to sufficiently interact with others via synchronous or asynchronous tools.

Table 4: Primary evaluation of the collaborative learning task

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were your cyber entity (avatar) looking like you in real-life?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.43</td>
<td>1.43</td>
</tr>
<tr>
<td>2. Were you able to interact and collaborate more effectively with your team?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.44</td>
<td>1.47</td>
</tr>
<tr>
<td>3. Was there a relatively easy way to direct your avatar in the 3D visual environment?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.78</td>
<td>1.27</td>
</tr>
<tr>
<td>4. Did gestures help you to communicate effectively with other members?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.68</td>
<td>1.88</td>
</tr>
<tr>
<td>5. Were Open Sim artifacts (scripts, textures, note cards, menu selection and direct manipulation) easy to use?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.13</td>
<td>1.23</td>
</tr>
<tr>
<td>6. Do you think nearby voice chat and brainstorming - typed applications, exchanging views and ideas between users, which are being responded from the system?</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>4.12</td>
<td>1.22</td>
</tr>
</tbody>
</table>

In order to be determined the intervention effect on users’ learning presence, Table 5 (a=0.78) penned that almost all participants motivated and studied collaboratively as a team to succeed their common purpose. As a community, students also seek to explore collaboratively with other peers the new dimension of inquiry-based learning in a VW.

Table 5: The users’ co-presence in the virtual community

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was the instructor correctly informed all members about the aim of the course and explained why the</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.17</td>
<td>2.23</td>
</tr>
</tbody>
</table>
lesson took place in the VW?

2. Were the well-structured activities allow you to participate in the dialogue and express freely queries? 35 3 5 4.34 2.37
3. Were practice-based activities really complex during your introduction? 35 3 5 4.18 2.27
4. Did you feel comfortable as an avatar to interact with other participants in the learning process and this really helped you to motivate as a community member? 35 3 5 4.56 1.83
5. Did the realness of the 3D “window” environment influence your feedback with other teammates and the instructor during the creation of artifacts? 35 3 5 4.03 2.22

It is pretty remarkable that in Table 6 (α=0.79) can be articulated students’ views about Open Sim that were positive. The implementation of this project-based course was succeeded according to the schedule and helped students to study in an alternative way (see question 5). The instructor’s feedback in the IB[C]L process was very significant for students as well as the constructive dialogues for the cohesion and coordination of their groups.

**Table 6: Students’ views for the learning process**

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did the instructor give you clear instructions on how to participate in the learning activities?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.17</td>
<td>1.23</td>
</tr>
<tr>
<td>2. Did the instructor give a specific timetable for the development of learning activities?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.74</td>
<td>1.17</td>
</tr>
<tr>
<td>3. Was the instructor’s presence useful for guiding other members’ coordination for the relating course issues?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.98</td>
<td>1.97</td>
</tr>
<tr>
<td>4. Did the instructor keep the students’ interest in high levels to participate together with others in a constructive dialogue?</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>3.96</td>
<td>1.48</td>
</tr>
<tr>
<td>5. Did the instructor try to maintain the concentration of courses in a way that helped you to learn in a IB[C]L script and explore collaborative issues related to your knowledge field?</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>3.93</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Notably according to the results from Table 7 (α=0.76) it can be mentioned that the IB[C]L script was implemented equally satisfactory in socio-cognitive project-oriented pedagogical strategy. It is also worth noting the fact that finally students succeed to participate with others in online and face to face settings based on a well-structured and well-organised inquiry-based framework.
Table 7: Students’ opinions about the inquiry-based script

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was it able for you to acknowledge and specify with other learners your personal interpretations or experiences in Computer Science courses?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>4.04</td>
<td>1.63</td>
</tr>
<tr>
<td>2. May the Open Sim directly fostered the acquisition of knowledge with the utilization of various media forms?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.47</td>
<td>1.77</td>
</tr>
<tr>
<td>3. Was the programming process efficiently connected to your prior knowledge in a collaborative climate?</td>
<td>35</td>
<td>3</td>
<td>5</td>
<td>3.91</td>
<td>1.97</td>
</tr>
<tr>
<td>4. Was the investigation of the main problem identified well in the virtual platform in order to be promoted “artifacts-to-think-with”?</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>3.56</td>
<td>1.88</td>
</tr>
<tr>
<td>5. Was the learning process emphasized in collaborative inquiry-based process help you to learn in better circumstances?</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>3.66</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Discussion

The present study examines an IC[B]L script with the utilization of Open Sim in order to be better measured the collaborative interactions between users and to be identified more clearly their opinions and views about this script. Xie and Ke (2011) have stressed that with interaction and autonomy issues that a learning platform provides students affected positively to participate in a collaborative climate and this distinction may increase their motivation for implementing learning activities. It is also important to note that participation in the discussion session through learning environments can offer more relative motivation and peer feedback between students.

According to the aforementioned reasons and taking into account this study’s findings it can be finally understood the necessity of designing and implementing courses in VWs. It is necessary to re-consolidate a methodological framework to transfer a novel knowledge field that suggested new ways of presenting or condescend to the contemporary educational contents and better learning outcomes.

The purpose of evaluating Open Sim must take into account the educational needs of instructors and learners by giving them full control and an increased sense of responsibility among team members. Supplementary the present study have proved that Open Sim has also advantages and disadvantages as a candidate learning platform. The advantages atoned to the social interaction between the users’ communication through a variety of multimedia artifacts that may become even from the persistent virtual place. Although, before the students’ introduction in the VW, it’s firstly necessary:
(a) To be provided Open Sim as a virtual “eco-system” or as an innovative educational tool for enhancing the collaborative climate between users with the learning materials (see answers from Table 4 and 7).

(b) To be covered all types of users’ learning progressions (visual, auditory, kinesthetic) in order to be reinforced the students’ co-presence, built-in programming courses in the artificially-advanced 3D environment (see answers from Table 4 and 7).

(c) Support effectively the user management responsibilities the primary research findings through the utilitarian presentation of results with synchronous or asynchronous forms of communication (see answers from Table 2, 3 and 4).

(d) Investigation of 3D virtual design possibilities, perception of the virtual space and interaction with learning activities that can raise the production and implementation of a new knowledge domain (see answers from Table 3 and 5).

On the other hand the inquiry-based learning process in Open Sim based on students’ opinions was very interesting, easily configurable and applying with the enthusiasm of all groups (see answers from Table 3, 4 and 7). The advantages that observed from the whole process were the following:

- Strengthening the students’ collaborative thinking and investigation from sources that Open Sim can provide for their common goal.
- Enhancing a novel knowledge field through an inquiry-based collaborative context
- Motivating learners more easily as a 3D collaborative platform.
- Encouraging the initial solutions from teamwork activities.
- Reanimating the development of attitudes towards collaborative processes with other peers.

Although there appeared some disadvantages like bad behaviors from the same users which may influence them negatively or even other lagging issues in server-based grid, but in any case it may not repudiate the whole approbation of transferring and producing a novel knowledge field. These were also identified as follows:

- It is a very laborious and time consuming an IB[C]L process for instructors who try to assume the learning procedure in collaborative scripts and for trainees because it requires intense physical or mental effort from all members.

Apparently, there are some other practical problems with the implementation, e.g. in most educational institutions have made classrooms which cannot allow the coordination of small groups and for this reason students needed a platform that
can provide a strong meaning of the co-presence. Using the 3D graphical GUI of Open Sim generally was justified positively by the advantage that gives to users with the sense of co-presence in a “simulated cyberspace” offering potential interaction between visual objects and users (see answers in Table 5). In addition for the same platform users had a great variety of possibilities. One of the main exponents is the stable release of the platform, and particularly the upgrades that could help further the learning process. Beyond that, the functionality that has been implemented was quite “impressing,” and allowing users to co-manipulate the learning material cooperatively or create “artifacts-to-think-with” and modify easily the OSSL with its visual effects to be provided to all users in a common place. Indeed, it’s important to observe the fact that the platform can support an open source language expecting to see the contribution by the community of developers.

Based on the evaluation results that presented above, it is understood that Open Sim platform combines a variety of features, supporting communication and cooperation processes, improving the students’ performance levels. Although, to be more competitive the appropriate study beyond to the traditional approaches (e.g. face to face), current transfers and affordances should be strengthened more. The current case study surmised some important primary results with advantages over innovative instructional formats and in this vein it was provided the pedagogical affordances of Open Sim through students’ suggestions, comments and requirements.

Conclusion

In the contemporary era, it is also imperative for instructors make students able to generate new knowledge and new ideas in innovative learning platforms. On this occasion it should be designed learning strategies in order to cultivate the students’ intellectual curiosity to contribute their thinking inside and outside the classroom. In the epilogue it should also be noticed that it was particularly examined the approximation of the new knowledge in computer science course via an IB[C]L script and not what actually have students learned. The research objective investigated mainly were three serious issues for educational purposes: (a) the emotional response of participants (e.g. attitude, satisfaction and critical review of issues), (b) a final assessment of collaborative learning in the inquiry-based context, and (c) the development of social interactions with well-organized frameworks allowing the free exploration of an issue without restrictions. Finally, it seemed that students were generally satisfied with the possibilities of free movement through a 3D space, the possibility of cooperation with other peers and sharing different simulated experiences.
The affordances from the implementation of the current project in the computer lab have caused: (a) the avoidance of the students’ primary "cognitive overload" that usually happens after their introduction in the virtual world, (b) the removal of any initial reactions, which are usually exemplified through the unnecessary and excessive use or navigation in the virtual environment, without the necessary feedback and (c) the achievement of a more direct guidance, both directly, with the presence of teacher (face-to-face), and indirectly (through avatars).

The research proved that Open Sim can effectively be integrated as an “educational tool” of Web 2.0, and a part of the learning approach. Furthermore, to answer the main research question which is based on the users’ primary evaluation results that presented above, it is understood that Open Sim can combine a variety of visual features, supports communication or cooperation in a virtual community, facilitating an IB[C]L script and with the instructor’s guidance students improved better their performance levels in Computer Science. It was finally discerned that Open Sim can offer the following technological features to their users: (a) a common 3D co-modifiable place (grid) that can be constructed only by the same users, (b) the students' actions were implemented at the same time and real time interaction with appropriate feedback were conducted through verbal and non-verbal communication forms and (c) the sense of co-presence which enhances the users’ personal identities in team-based activities.

The common 3D virtual space allows the users to freely browse, interact and convey information users with others. It also provides the implementation of simulations involving facts, phenomena, processes where the equipment is not physically accessible because of its cost or other risks. Within VWs users can be organized in communities choose how users can interact anytime with their peers and how the environment’s tools can afford the implementation of collaborative scripts. This freedom of interaction in a simulated learning environment that is pre-made bestow students to learn safely (if the administrator control the server-based virtual world) in order to be observed the consequences of their mistakes and on this occasion to give the appropriate feedback to students and repeat the attempt to solve an issue as many times as they wish.

The contribution of this study was the presentation and evaluation of an IB[C]L script that is significant for the organization and cohesion of students’ groups. This effort may significantly impact the coordination of avatars in a 3D VW, something that is crucial and complex. It was also revealed that the use of Open Sim for Computer Science courses can reinforce students attention and collaboration because of: (i) the good representation of the information that it is provided to users, (ii) the "transition" of spatial information in a secure manner, (iii) the experiential learning or active participation of users with increased motivation
and engagement in an IB[C]L script, and (iv) the effective collaboration of each student with other peers.

Conclusive remarks the utilization Open Sim can be done in three main ways:

(a) as a virtual space for communication between users with synchronous or asynchronous forms in order to be produced a novel knowledge field for spatial simulations,
(b) as an open-ended space for the implementation of experiential-based experiences with frameworks from a real or an illusionary world.
(c) as a candidate learning platform which engages students to participate in meaningful and purposeful collaborative learning tasks.

An interesting future-driven study may investigate the conjunction between Sloodle (free plug-in of Moodle) with Open Sim based on the IB[C]L script for students who didn’t have previous experiences with 3D visually-rich environments. In some other case studies it may be useful to be conducted a research that may measure the impact of 3D VWs on students’ engagement factors (behavioral, cognitive and social).

Limitations

Some of the most notable limitations that should be considered for the current findings are:
(a) The sample size was voluntary (35, i.e. 46.6% correspondents of the total 75 that took part of the spring semester) and only from the Kavala Institute of Technology in little less middle response.
(b) The project-based courses were limited to one month because the study took place in the April 2011 and students have to devote their time to university-level courses or other workshops and preparations.
(c) The current study was deployed in blended sessions that held in Open Sim with the instructor’s feedback to be sufficient and daily.
(d) Students’ characteristics may differ from other universities and the results of this study cannot be generalized beyond all other educational programs at university-level courses.

References


