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**Abstract**  
Nowadays the dissemination and exploitation of three-dimensional (3D) multi-user virtual worlds in Higher education have been disclosed from their widespread acceptance as candidate learning platforms. However, it is still lacking a theoretical cybernetic macro-script in order to elaborate the coordination of multiple complex interactions among users’ participation. The purpose of this study is to present and articulate a cybernetic macro-script focused on the systemic organizational structure replicated through the conjunction of cybernetic structures proposed by the Viable System Model (VSM) and the Jigsaw teaching technique in order to be amplified an exploratory-collaborative learning process which may engage students in argumentative knowledge construction. This approach may allow educators and scholars to handle efficiently the cyber entities’ (avatars) in-world complex interaction through purposeful participatory learning tasks. A cybernetic macro-script held in Open Sim can be sufficiently established as valuable with insightful perspectives by surpassing irrefutable shortcomings for future-driven sustainable use and growth.

**Keywords:** collaboration; computer-supported collaborative learning; cyber entities; cybernetics; Jigsaw; macro-script; Open Sim; Viable System Model

**1. Introduction**  
In this contemporary era, the technological growth of Web 2.0 has offered many possibilities in order to be implemented different teaching and learning scenarios. More specifically, Web 2.0 transactions helped instructors or administrators to be produced in their learning material on the one hand and on the other to be acknowledged them more efficiently a plethora of innovative digital resourceor platforms which can lead to new ways as candidate learning environments. With the advent of social media sources and especially those with an open source code endorsed in two-dimensional (2D) or in three-dimensional (3D) multi-user virtual worlds, it is possible to be replicated a visually-rich content that can also drive in more constructive understandings of learning. Meanwhile, there is also a radical change determining the teaching process towards a student-centric instructional formats with an additional aspect of computer-supported collaborative learning (CSCL) to be a newly, but still fundamental term that is currently being used.

From this point onwards, it was placed the foundation of CSCL training sessions in an ever-changing society where each user (instructor and student) belonged or it is a milestone for the consolidation of a successful collaborative learning process (Gesche & Makehan, 2008),
Noteworthy, there are highlighted many pedagogical points of viewby creating teaching and learning conditions in 3D multi-user virtual worldsthat may cause the users’ active involvement, mainly to those who attended in Higher education sectors. These mainly are (Okita, Turkan, Kim & Murai, 2013): (i) the construction of self-directed or collaborative processes, (ii) the co-manipulation of a pre-constructed virtual place, (iii) the experiments without spatio-temporal psychical distractions or dangerous consequences. Furthermore, as students grew cognitively and emotionally with their peers in a school climate they must be adopted and enrolled with cooperative and interactive activities held in a socially engaged environment.

According to the aforementioned it is needed to further examine carefully the design decision processes (pedagogical strategies and appropriate learning activities) which are very useful for the positive learning outcomes in 3D multi-user virtual worlds (Petrakou, 2010). Moreover, it should be explored a number of factors which may influence collaborative learning in virtual worlds, such as interactivity, fidelity of representations (avatars) in well-structured learning spaces and media devices that offered in three-dimensional virtual environments (Dalgarno & Lee, 2010). Additionally, in a research level, it would be therefore useful before the selection and utilization of a virtual world to the instructor to understand first of all the modified learning space in which users can interact together and support the principles of a collaborative learning framework.

Recent studies (Liang, Hsu & Huang, 2012; Pellas & Kazanidis, 2013) have shown that the contribution from the pedagogical use of technologically-advanced virtual worlds has transformed them as valuable candidate platforms for the learning process. These dimensions were important because of the potential expression, creativity and interaction among stakeholders in the educational process in which the learning process emerged in various tasks. In recent years the use of multi-user virtual worlds according to a growing literature academic body in Higher education (Konstantinidis, Tsatsos, Terzidou, & Pomportsis, 2010; Pellas & Kazanidis, 2012; Pellas, 2012) has provided some fundamental instructional affordances emanated from the possibilities of the environment that can be adopted for collaborative or constructive learning procedures or even from users’ interactions with the learning materials (Pellas & Kazanidis, 2013).

3D multi-user virtual worlds can become useful for participatory learning processes, leading to a better cohesion or cooperation among students’ groups, in which endorsed their interactions, but this process is still becoming a remarkable and innovative proposal (Lee, 2013; Ibáñez & Naya, 2012). A CSCL approach as a novel participatory approach is based on web-based transactions which are able to support and facilitate the dynamic dimensions among groups that sometimes cannot be attained through the real life’s interaction (i.e. during face-to-face communication and collaboration of students). This treatment may also reinforce equally the users’ communication in a virtual world.

Perhaps the most important contribution of these novel technologically-advanced environments retrieved from the inherent infrastructure offered by the three-dimensional virtual reality technology in which can be facilitated a participatory learning task. Indeed, 3D multi-user virtual worlds considered to be as one step further from the non-interactive technologies offered by Web 2.0 sources (social networking sites, blogs or wikis) due to the various synchronous or asynchronous communication forms (VoIP, chat text) delivered. Users can interact in a common virtual environment with synchronous (gestures, chat text, VoIP) or asynchronous tools (IM) or co-manipulate artifacts (prototyping virtual modules) to achieve and understand sufficiently the meaning of collaboration and communication in an innovative knowledge field.

The multi-user and open source virtual world of Open Sim was utilized in this case to coordinate and collaborate students together in order to construct their own “knowledge field” easier with a macro-script. This process reflects as an educational perspective which may influence the learning process more indirectly (as a method utilized with a macro-script) and allowed students to have a sense of flexibility and autonomy for studying freely with other peers. Two of the most relevant points of view for the added value for this macro-script were:
a) The choice of CSCL macro-scripts located at the intersection of the instructional design and socio-cultural learning approach (Thounikine, 2008).
b) The design and implementation of a collaborative scenario requiring an arrangement of main pedagogical aspects which are crucial for the reliability of the entire CSCL field (Dillenbourg, 2002; Dillenbourg & Hong, 2008).

1.1. A rationale for the utilization of virtual worlds in collaborative macro-scripts with the Jigsaw teaching technique

Recent “conventional” educational practices with Course Management System (LMS) or Massive Open Online Courses (MOOCs) in Higher education were primarily based on the oral or written communication forms and (re-)presentations of knowledge in different disciplines or answers in theoretical problems which were usually delivered by the instructor who acted as an “expert” on the one side, but on the other students could not recall or take the appropriate feedback from their instructor in real time. This approach has been a target of criticism because (Pellas & Kazanidis, 2013): (i) the learning materials were not always grounded to students’ understandings and their prior experiences from the real world; (ii) the self-directed learning and critical thinking skills weren’t sufficiently cultivated, because of the students’ disengagement in various educational activities; (iii) students did not possess the appropriate skills to apply the acquired knowledge to real-world problems which are often not well-established.

The vast majority of scholars and educators (Iqbal et al., 2011; Pellas, Peroutseas & Kazanidis, 2013) have discerned online three-dimensional multi-user virtual worlds as a powerful magnet for distributed users, giving incentives for the socialization and the creation of social networking systems. The most significant feature of three-dimensional virtual worlds is that users can share their common experiences in social activities. These “worlds” are defined as complex communities characterized by a full range of social and material-practices, where young users introduced gradually in a complex social context (Steinkuehler, 2004). Some other researchers (Gee, 2010; Dalgarno, 2002) have suggested that multi-user virtual worlds can effectively be used in e-Education with different instructional formats (online or blended) and in different learning disciplines.

By utilizing the open source virtual world of Open Sim, users are able not only to have the responsibility to transfer an innovative knowledge field in a common virtual place. By structuring or preparing educational applications, students not only need to train their cognitive skills, but also acquire several managerial responsibilities, according to the gained information and social skills that being emerged from the a-synchronous communication forms with others. Students can interact in team-based activities through virtual classrooms and may also be supported a collaborative interpretation of the scope that it also emanated from a CSCL approach. However, this approach is certainly not indicative on abstracting different learning dimensions, but like all educational processes need to have a perspective valuable guidance or support from the instructor in order to succeed the purpose of education with this technology, i.e. the easiest way to “learn students something by doing it”.

The combination of contemporary CSCL approaches has currently resulted from the idea that technology-enhanced literacy in virtual worlds is something that currently has been growing at an exponential rate. The knowledge construction as a collaborative process can allow users to co-construct their knowledge field and this can be combined with the Jigsaw teaching technique to be produced the anticipated learning outcomes from a collaborative process (Lao et al., 2008; Perkins & Saris, 2001). The main objective of this cooperative assembly is to make every member of a heterogeneous group to participate in a cognitive modeling process able to interact with others and take not only initiatives but also responsibilities for teaching a specific module to the other members (experts). In this way, team members are enabled in the context of a collaborative learning scenario with a macro script to achieve a common goal, depending on their individual contribution.
The Jigsaw technique was used on this occasion in order to be reduced the racial conflict and support positive educational properties (Aronson & Bridgeman, 1979; Huang, et al., 2008). Like a puzzle game, the contribution of each piece, i.e. expert or simply a member of each group is an essential and integral part, in which each student required to complete and exercise problem-based tasks to provide the anticipated outcome to all other team members. The Jigsaw technique can empower students’ participation and collaboration to construct their own knowledge through successive engagement in both original group discussions and in expert group discussions.

However, when students as experts return to their original group to share their experiences with teammates, they may need to review the records of the previous discussion in order to integrate and share the basic ideas raised from this discussion. The Jigsaw teaching technique is considered as one of the most remarkable teaching techniques that can efficiently support participatory learning scenarios in a socio-constructive framework, even in three-dimensional multi-user virtual environments (Pellas & Kazanidis, 2012). With the use of this technique, users can cooperate and coordinate their actions easier in collaborative groups to achieve a common goal. This technique may improve the capacity to develop interpersonal and interactive relationships among users by adopting several roles resemble those of reality. Each user as an iconic figure (avatar) involved with adigitally-embodied presence.

The cybernetic macro-script that enunciated in this study combined with the principles of the cybernetic administration and organizational structure for handling the complexity of users’ interactions in Open Sim, according to the Viable System Model (VSM), as it was formulated firstly by Anthony Stafford Beer (Beer, 1979). Moreover, the current framework that proposed may give scholars and educators the possibility to create and implement an innovative pedagogical “cybernetic” macro-script based on the Jigsaw collaborative technique in which there are being created from the distinctions between members (expert and novice level), but worked together for a common purpose.

Notwithstanding that many studies have already implemented different learning scenarios held in virtual worlds (see literature review from Inman, Wright & Hartman, 2010; Wang & Burton, 2012), it is still open the discussion on how can educators or scholars better handle or operate students’ complex interactions with an organizational-teaching framework in multi-user virtual worlds.

The purpose of the current cybernetic macro-script is to elaborate the collaborative activities between online sessions where students enrolled and sufficiently cannot carry out on their own; whereas they introduced for the first time in Open Sim. Regarding the users’ collaboration and acquisition of knowledge that is always needed, there remained a lot of challenges that this approach may provide which is the continuous adaptation of a learning approach via a macro-script. Efforts to define or standardize the components or mechanisms of collaborative scripts may lead effectively to the creation of a growth-promoting technological literacy through original CSCL scripts. From these perspectives the creation of a guiding framework for computer scientists, psychologists and educational scholars seems to be imperative and urgent. The present conceptual-cybernetic macro-script can propose an innovative plan about what a collaborative approach by utilizing a macro-script in a three-dimensional technologically-advanced environment can consist and assist the instructor to handle the students’ interactions.

2. Background
2.1. Three-dimensional multi-user virtual worlds with open code infrastructure
Three-dimensional (3D) multi-user virtual worlds are defined as computer-generated environments responded to users’ actions in real-time visual and auditory stimulus with their basic elements to be as follows:

(i) The illusion of a three-dimensional place or space where users as avatars can interact together in a visually-rich “physical” environment.
(ii) The communication forms between peers by utilizing verbal (VoIP, IM, and chat text) or non-verbal forms (e.g. gestures that composed each user’s emotional state with facial expressions or body and communicate others).

(iii) The “persistence” workflow (i.e. a world that still exists even when users log out of it), and this workflow can precisely be modified for the same users (sense of autonomy in a common virtual space or place).

Many researchers and scholars have used temporary the three-dimensional virtual reality technology as a constructionist tool, where its features can be combined adequately with other artifacts in order to be constructed a truly novel platform to empower the learning procedure. Some of the most fundamental features that can reinforce the learning process in a virtual world are (Pellas, 2012; Pellas & Kazanidis, 2013; Sherman & Craig, 2003):

(a) the (co-) manipulation of the time’s or space’s sense, specifically where students need to practice in a common virtual space to co-create three-dimensional visual prototyping to design easily tangible artifacts and simulate users’ behaviors or characteristics of their artifacts;

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

(c) the sense of interactivity from the co-construction of students’ artifacts and simultaneously with activities in a multi-user environment can drive to a narrative workflow for the learning experience in three-dimensional visually-rich contexts;

(d) the scripting and animating usage of constructive scripts for the creation of functional prototypes;

(e) the innovative persistent workflow is easily configurable. This dimension is significant because virtual worlds cannot become learning platforms per se, and in this vein students should work in a three-dimensional multi-user environment which must be manipulated at the beginning according to their needs or demands.

The legalization (validation) of functionalities implemented from Open Sim was the highest response from the system’s server that can provide a positive effect on the cooperation between distributed students (Dohi & Ishizuka, 2009; Rico et al., 2011; Ryoo, Techatasasanasoontorn, Lee & Lothian, 2011). The logic conviction and a rationale behind the choice of its utilization from educational designers can significantly affect the suitability of this platform in e-Education. This premise may frequently be recapitulated when scholars amplified certain factors that can affect the participation of users in these environments.

Hence to summarize the affordances developed from these interactive dimensions are predominately offered due to the communication forms that an open-ended virtual world can provide synchronously or asynchronously. Some other important benefits are the following:

(a) The low or without cost performance of learning, contrary to the social virtual world of Second Life where items or islets (grids) need to be rented and paid monthly.

(b) Virtual places or spaces modified and manipulated by the same users which means that they need to modify, co-construct and co-manipulate everything at the beginning.

(c) Portability, transferability, and “backup” issues in a standalone mode can be completely transferable from the administrator who has the main server to control the entire grid.

(d) The ease-to-use macroscopic or microscopic configuration and manipulation of a simulated virtual space or space.

Virtual worlds in these dimensions can effectively support collaborative learning activities and foster the development of students’ cognitive, social or communication skills (Conway et al., 2011; Leong, 2011). Ideally, educational organizations and institutes have demonstrated considerable interest to explore teaching and learning possibilities in virtual worlds (Bouta & Retalis, 2012; Dieterle & Clarke, 2008), while many corporations and agencies investing them seriously for future-driven training sessions.

2.2. Administrative and managerial responsibilities for cognitive structures
The term of "knowledge management" in virtual worlds until recently seemed to attract many researchers and scientists (Joaquín, David & Carne, 2010; Levy, 2009; Paroutis & Saleh, 2009). The above researchers keen to explore the purpose of the knowledge acquisition in interactive virtual environments. Before getting to the point of this investigation, they should be able to recognize other research approaches according to some conceptual determinations which may directly affect this approach, as the “theory of knowledge” based on the effective organization plan (Manovich, 2001; Velentzas & Broni, 2011).

Thusly, it should be given more attention to the organizational analysis of interactions that are being emerged each time to become clearer the scope and impact of learning and subsequently to be avoided the fragmentation of knowledge (Nonaka & Nishiguchi, 2001). Meanwhile, it can be said in the outline that knowledge management may have as a common goal: the creation of databases or corporate knowledge bases where information can be stored in the system and can be reused in future-driven activities. Worth bearing in mind that users should create multiple knowledge sources in order to have information from a variety of different cognitive sources.

A fundamental piece of research that is inseparably introduced during students’ interaction in a digital learning environment must be currently connected with the management of cognitive structures and the analysis of interactions during the users’ experiences in learning activities. Different types of educational environments and three-dimensional multi-user virtual worlds often provide an evidence of interaction between learners and systems (Redfern & Naughton, 2002). These assets have been used in multiple ways in the educational environment in order to advise/guide learners and adapt their behavior to the current situation as an evidence of co-presence. This concept is intermittently envisioned in the contexts of a collaborative effort with the users’ coexistence and persistence in virtual communities, while in the case of the latter it still exists, even if any user removed from the world. Although, the co-manipulation and modification of the three-dimensional pre-constructed virtual place can be gradually growing by other peers.

Data from students’ interactions generated by recording users’ actions in the virtual environment, setting in this process the main objective of a learning activity including:

(i) The navigation and selection of tools or educational materials chosen by students have changed the learning environment that users can handle and utilize freely.

(ii) The communication between students with the instructor with a non-faceless character due to the students’ embodiment representations in a common virtual place.

The students’ interactions in a virtual world area complex issue and at a large extent it is provided during a real sequence of actions that they need to undergo for a proper treatment and provided to them as useful and meaningful information. Thereupon, a significant challenge is how can be created a framework for describing users’ actions that interpreted different aspects in an interactive environment. With this dimension can play a pivotal role in which virtual representations (avatars) observed self-assess with various possibilities in a learning process or regulated their learning and progress status (Martínez-Monés et al., 2006; Pellas & Kazanidis, 2013).

The corollary of the above is to understand that an effective method of managing teaching and learning situations can become the main area of an educational system, because this process may determine and provide users the necessary mechanisms to become the “backbone” of its destination which seemed to be crucial in the learning process. Although, the development of creativity, performances on teachers’ continuous improvement in order to meet users’ needs, the participation of all members to achieve efficiently a common purpose, and thence the competitive academic environment developing or composing future-driven managerial requirements and responsibilities to all users that must be further investigated (Britain & Liber, 2004; Elkjaer, 2003).

2.3. Theoretical foundations of a systemic learning approach

The systemic thinking is based on the critical understanding of complex system emphasized on the correct structures of the entire “system” rather than to a sum of its
parts. This thinking process is particularly noteworthy for education, because it focused from static to dynamic situations of the system (Maani & Maharaj, 2004). The systemic approach in the context of a sustainable/viable educational system can also be refined from “what, how and why” someone may learn something.

In a learning point of view it is recognized by several sustainability issues which are multidimensional. Systemic approaches are promoting non-linear models of teaching and learning approaches, in which learning through complex problems is associated with the sustainable development of learning activities that are being adopted in an environment. These types dealt not only by understanding users the components of a situation or an issueresulted, but they are mainly regulated on linking learning process in a broader context in which students really occurred (Blandin & Lietaer, 2012). The systemic thinking may challenged with the separation and the entrenchment of e-Education beyond the knowledge that is gained in a well-structured and flexible curriculum, whereas educational process supervened through formal or informal learning approaches (Gharajedaghi, 1999).

The technological evolution of the 20th century with the automation of machines rooted from the cybernetic theory (i.e. the science of control and communication between people with computers) has created theoretical frameworks focused on educational approaches with technological meaning (Wiener, 1965). This does not differ from the content of the learning material, as the medium established to organize the material, but eventually an urgent question is who digest on its users better. This theory interested in how the interaction between humans and computers can be combined in the educational process and become more efficient.

Some indications key characteristics of this process may focus on (Krippendorff, 2007; Petrina, 2003): (a) the adoption of this terminology, e.g. interaction, hypermedia, programming, (b) the shift of interest mainly to the teaching and instructional design, (c) the persistence of the data according to the various communication forms, (d) the feedback from the environment, (e) the widespread use of communication technologies, and (f) the determination of advance goals and expected human behavior.

Within these frameworks, two trends that developed are: (a) the systemic (or systems’) theory dealt with the organization plan of teaching elements and the design of prototyping mechanisms, (b) the hypermedia environment, and (c) the management of these technologies of the entire (media) system.

A systemic learning approach can lead to the description of hypermedia elements with the pedagogical systemic theory in a new processing data. This referred to the classical view of the cybernetic theory that involved the human’s thinking as a communication system that interacted with the environment’s interface (Vrasidas, 2002). This view is based on the classical analysis of Weaver and Shannon (1963) adopted in the social science fields, such as education, organizational analysis, and psychology (Merrienboer & Kirschner, 2013). Jantsch (1975) has also argued that “cognitive systems” evolved in real life’s situations as humans with the feedback that a system provided can inform their activities. Winter and Thurm (2005) on the other hand have considered that it is essential to train people in cybernetic thinking settings, something that can help them to think in the context of “systems” instead the traditional concept of the entire system separation into several small pieces for analysis. Today the example of cybernetics seemed as necessary for the improvement of humans’ thoughts (Velentzas & Broni, 2011).

2.4. The Viable System Model

The rapid proliferation of e-learning programs that many universities and institutions confront today is a difficult problem due to the decisions that should be made to choose, manage, and understand their technological infrastructure which may fit into their budget, technical resources, curriculum, pedagogy, and the profile of the student body. It is a common conviction for contemporary e-learning practices to use virtual environments (or worlds) and include studies of the pedagogical models related to innovative teaching methods or models (see problem-based, project-based or inquiry-based learning methods).
The Viable System Model (VSM) can offer an alternative modeling agency which can be used as a “diagnostic” tool for the existing organizations (Jackson, 2000). It was developed by Stafford Beer and its construction was based on the field of a cybernetic structure focused on the effective management of several organizations. The VSM differed from other organizational models (Flood & Jackson, 1988; Schwaninger, 2003) and highlighted those conditions that can create and support a viable organization. As a “viable,” it is defined “a system that it is capable to maintain a separate existence” (Beer, 1985, p. 157).

The present model focused on the interactions of an organism with the external environment and effectiveness of the internal communication channels or information that is provided. Therefore, issues of the VSM integration in virtual learning environments (Britain & Liber, 1999) should involve the following processes:

(a) Negotiation: Firstly, the learning management unit needs to negotiate with the available resources and modules that should be reconstructed. Typically this performed at the beginning of a learning program, but this may vary depending on the learning progress.

(b) Coordination: The coordination of modules should be designed in order to help and operate independently each student because some of them are considered as prerequisites or co-requisites of the entire learning activity.

(c) Monitoring: The monitoring phase is the regular observation of activities taking place on a project or in a program. With this procedure, users collected all the necessary information in an easy way in order to check how the project’s activities were progressing simultaneously. It is a systematic approach deliberated from the observation phase which may provide the prompt feedback on the progress of a project program. The report allowed the gathered information to be structured for improving project performance and made valuable decisions.

(d) Personalization (or Self-organization): In many institutions the instructor should reveal her/his opinion with the continuous assessment and reviewed the students’ activities in the environment.

(e) Adaptation and balance of needs for present or future-driven trends: Any online learning program must constantly examine the set of modules and considering whether the most appropriate changes are needed in the knowledge domain, according to the demands of society, and new available resources or capabilities. A further idiosyncratic situation referred to the enhanced technology which has a large part in this, but usually it is not integrated in virtual worlds, where the needs of the adaptation are expressed.

As it was unveiled in accordance with the above literature, there is a general trend or an attempt for implementing learning tasks at the best design and management situations of learning initiatives in contemporary learning environments in order to improve the quality of teaching and learning-centered learning processes in participatory settings. A basic premise guiding the development of the framework presented in this effort ownership by students with new technological infrastructure included virtual worlds as alternative platforms for organizing learning in different instructional formats. It was also demonstrated that the organizational structures both at a technological and pedagogical-didactic level can offer important learning processes in order to transform a virtual world in an educational platform with a significant impact on students’ engagement (Pellas & Kazanidis, 2013). Consequently, it can be proposed a particular context analysis of interactions through a cybernetic endorsement of virtual worlds which particularly should be designed for the purposes of knowledge management of the learning material with a rationale in which instructors can handle students’ interactions with a well-structured teaching process.

Based on these data, it can be proposed an innovative organizational learning-teaching context in which it can become a theoretical approach which: a) can describe the framework for organizing learning in a virtual environment Open Sim, b) can record significant learning conditions that should be made in the environment with the use of communication tools and c) may define the contexts in which can be used a cybernetic macro-script for applying different and flexible teaching processes. In this way, it is considered that even at an early stage this approach can give some conclusion quotes on how educators and students can use virtual worlds as alternative learning platforms, upgrading the quality and characteristics of a
learning environment that cannot be offered in a face to face environment and should give instructors a systemic-holistic way for organizing teaching frameworks collaboratively by students to gain easier knowledge.

It is also important to be mentioned that VSM constructs in contrary to other models (see for example the conventional) elaborated the learning management levels in three interlocked dimensions (Britain & Liber, 2004): (a) the course or module level (innovative circumstances from the utilization of contemporary instructional formats), (b) the program level (the users’ managerial responsibilities in team-based activities), and (c) the learner’s level (adoption of the gained knowledge due to each student demands).

With the main focus on this idea, it is believed that the construction of a macro-script can be better showcased features of Open Sim, and as well as contributed to a new way of managing students’ interactions depended on their needs or demands.

3. Method
3.1. The scope of this study

The scope of this research is to demonstrate, propose and articulate a conceptual cybernetic macro-script for instructors in order to handle the complexity of collaborative learning activities and students’ interactions in the virtual world of Open Sim. The main authority of this cybernetic macro-script was modeled among to the cybernetic management of the VSM and key principles of the Jigsaw teaching technique.

3.2. The key research question

A substantial research question that emerged was if a collaborative cybernetic macro-script can be developed in order to articulate the social-collaborative interactions between participants in a three-dimensional virtual world?

Particularly insightful for the present study is the added value of the proposed macro-script which can give a common basis to reach a potentially simulated cybernetic organizational-teaching framework in Open Sim emphasizing on the integration of the Jigsaw teaching technique.

3.3. A cybernetic macro-script

Dillenbourg (2002) has defined a macro-script as “a collaboration script that is a set of instructions prescribing how students should form groups and how they should interact and collaborate in order to solve a problem” (p.1). According to Weinberger et al. (2005) macro-scripts are pedagogical scenarios or models that typically set the appropriate conditions of a successful collaborative learning process prior to the collaboration stage. In these dimensions a macro-script can be utilized to induce the emergence of specific knowledge in productive interactions and mutual regulation among users. Macro-scripts are related to outlines or patterns of design in a learning scenario regarding the type of inter-psychological mechanisms which by promoting or limiting certain interactive communication dynamics between students is being emerged (Onrubia & Engel, 2012).

A collaborative learning macro-script in virtual worlds can be referred as a collaborative learning process in specific settings which presented with essential learning “horizontal” interactions between students and “vertical” between students-systems in order to be determined the conditions of an activity where users can utilize the environment’s characteristics. Resulting from the use of collaborative learning in education with the virtual world, most modern educational platforms were primarily designed to promote effective support collaborative learning scripts in a reliable and eligible of a CSCL approach. Also, the concept of “persistence” may involve other members to be fostered self-organization, collective action frameworks and co-responsibility to find solutions in problem-based situations (Gamor, 2012).

It is pretty remarkable that every adaptive system should be organized in a way to meet the users’ requirements (instructors and students) and three-dimensional manipulation of objects (virtual artifacts) in a continuing changing environment. The standard-mode of a VSM
described a cybernetic description applied by an organization promoted as a system that can provide autonomy (Beer, 1979). Eventually, the result of the decryption and development of a theoretical cybernetic model with the Jigsaw technique may give the opportunity to be described a learning procedure in detail, investigating also the cognitive skills and learning levels that learners acquired during a complex task (Pellas & Kazanidis, 2012).

Beyond the fact that related studies were previously based on the implementation of various pedagogical models, and innovative teaching methods (De Lucia et al., 2008); there is not any research concept for developing a macro-script which may combine the diversity of both Jigsaw and VSM learning phases to achieve a common integration in a virtual platform. One of the most critical issues that must be taken seriously into account with virtual worlds is not only how to allow a group (ranging from 10-30 students) to create an innovative knowledge field, but also to motivate students to distinguish elements that the virtual world proposed to them and how they can manage it correctly.

Therefore, the present study is based on Open Sim functional characteristics for presenting and creating a well-established didactical-organizational framework which can become essential for planning and conducting users effective learning courses (in this session it is referred a learning approach in online settings) (Figure 1).

Insert Figure 1 here

The creation of a simulated macro-script for researching the pedagogical value of Open Sim was created by:

(a) The organizational principles of the “Viable System Model” (VSM), which can be considered as the most appropriate organizational model of each system; and

(b) The teaching principles of the “Jigsaw” technique provided as the best solution to handle and promote collaborative work with common goals, assisting with students’ skills development and their interaction within virtual worlds (Villasclaras-Fernandez et al., 2011).

The key feature of the VSM permitted as an effective opportunity against the organizational complexity of natural and technical interactions that each system governed, making it more practicable to users. On an educational approach the structural axes of the VSM can determine the key elements of a cybernetic model and the corresponding effect on the development of a “cybernetic administration” in the teaching and learning process. The basic concern of this study was to be tackled the organizational complexity of Open Sim, as a unique collaborative environment through a systemic approach that the VSM proposed.

The main concept of this research wasthe adoption of a VSM fora better description of the technical requirements and pedagogical principles that every open source virtual learning environment governed. According this process, the construction of a theoretical cybernetic framework that is a tedious task should take into account the introduction of students to a virtual environment, bringing them into a collaborative group of learning rather than to simply provide the mechanistic process of encoding the information absorbed by the ordinary phenomenological exploration in a virtual space. Thus, a variety of educational issues, such as interactivity, adaptability, interaction and collaborative learning mentioned crucial, and these principles should adequately be provided by the VSM.

According to this process it would be provided the pedagogical value of Open Sim as a candidate learning platform. The contribution of the present research with a cybernetic macro-script can give a common basis provided the main access to a potential educational value of virtual worlds with an emphasis on integrating innovative teaching techniques. The basic concern was to prevent in considerable detail the mode of avatars (instructor and students) and the contribution of the three-dimensional graphical user interface (GUI). Foremost, reasons for imposing the visual presence with plausible behavioral and educational strategies need to understand students that are a veritable promising environment for e-Education. One of the most appealing features offered by these developments is the ability to create three-
dimensional visually-rich worlds with a student-centered approach to be consisted in life-like animated scenes with anthropomorphic idols (avatars).

In this condition it can be reconstructed a cybernetic macro-script for understanding the pedagogical value of Open Sim that should take into account:
(a) The description of pedagogical activities during the knowledge management practices relating to the systematic and collective creation of a knowledge field.
(b) The dissemination and use of new knowledge for improving the organizational efficiency, learning competitiveness and students’ cohesion (see the first column of Figure 2).
(c) The organizational context of the VSM structure should include the cybernetic management of an e-learning system between users and medium (Open Sim). Hence, it should be used the principles of Britain and Liber (2004) model (see the second column of Figure 2).
(d) The structure of pedagogical processes. In this case, students with the Jigsaw technique should be able to realize all those procedures which are noteworthy and necessary for the successful integration of technological tools in the curricula of Higher Education (Nonaka, Toyama & Byosière, 2001) (see the third column of Figure 2).

Consequently, there is no doubt that all these methods or techniques are remarkable for any e-learning platform, especially for virtual worlds. In this vein it is needed more than a simplify systemic methodology. The present papers try to propose a macro-script which may essentially combine a systemic methodology, based on the idea of Beer’s “cybernetic” model. In order to achieve the best results for this problem, it was developed a strategic knowledge management script for e-learning courses through virtual worlds. Finally, it was chosen the VSM to represent the complex phases of the previous steps and identified the strategic flow of knowledge management among members. Through this process, it should be configured the core of a cybernetic macro-script that can be implemented in virtual worlds and may include the following procedure (Figure 2):

4. Discussion

Nonetheless the adaptation of a VSM in Open Sim and its utilization for the coordination and organization of a learning process, it is still open the discussion that may consider to the ephemeral use of this cybernetic model in specific learning situations. First of all, the present study proposed a cybernetic macro-script, and more specifically a theoretical cybernetic flowchart for students’ activities according to VSM in order to reinforce the development of a systemic model and to propose the appropriate phases to manage users’ innovative knowledge field. The purpose of this research emerged specific theoretical proposals for consultants to the strategic management knowledge gaining competitive advantages from the virtual development or partnership agreements in order to preserve operational flexibility and innovation. This organizational-teaching framework provided by a cybernetic approach emphasized on the coordination of student groups in order to be conducted a more creative and understandable knowledge field, rather than a simplify observation in the direct intervention of the operating characteristics through the contemporary management of enterprise information resources.

Some evidence of validity for the effectiveness of the proposed cybernetic macro-script should also be better improved. Thus, with the proposed model it was tried to be articulated and elaborated an important part of the educational research given the fact that even theoretically it may be able to capture the various user interactions during the use of the virtual world. In a multi-user virtual world where the social formalization of learning takes place, it is most important for students to perceive all learning modules through different multimedia elements received from the environment.

Generally, the cybernetic approach in an open-ended environment can be considered as the most important in this contemporary era, as it can become more imperative the need for
knowledge management with the utilization of open source environments in which it would be possible at least to some extent, even in an unpredictable visual function to be usedartifacts created from the student groups and for learning purposes. Notable studies (Berns et al., 2013; Girvan et al., 2013; Pellas & Kazanidis, 2013) have argued with the idea that three-dimensional pre-constructive virtual worlds have already expanded their exploration and thus their technological capabilities encompassed an active participatory process by providing to users significant tools to rediscover a new knowledge field in different disciplines.

The current conceptual approach characterized the validity of a learning effort, in which student can be engaged with a cybernetic model that proposed and strengthened the students’ cooperation through the Jigsaw teaching technique. As for the logical sequence of actions, it can be said that some general characteristics appeared properly in a three-dimensional multi-user environment and opportunities that can be provided from students’ perspectives to understand easily and conquer the knowledge are also remain important and should be further explored.

The validity of the proposed model can be partly addressed by the main criteria from other generic models (Argyris & Schön, 1978; Britain & Liber, 1999; von Glasersfeld, 2002), which have been met to a large extent:

- A cybernetic macro-script should widely be recognized from its fundamental properties and processes.
- A cybernetic macro-script should reduce the complexity of students’ interactions in a virtual world.
- A cybernetic macro-script should provide a powerful and extensible “systemic” construct of a theoretical flowchart that is able to respond in problem-based situations.

Some of the most fundamental points of view for effective educational implications may constantly be raised from the cybernetic macro-script are as follows:

- Better coordination of team-based activities in conjunction with the Jigsaw teaching technique and specific learning domains not only can empower the dynamic dimensions of communication but also can reinforce the users’ collaboration to study together as a team for a common purpose.
- Better facilitation and enhancement of the cooperation and organization of learning among students with the instructor.
- Better management of students’ interactions through a “systemic-holistic” approach of a teaching learning model for virtual worlds.
- Better description of a “cybernetic” macro-script can make more understandable the technological capabilities of the teaching process that can be very insightful for students during the introduction and implementation of workshops in virtual worlds (i.e. the sequence of activities).

The systemic effect of this cybernetic model in the practical-teaching framework by using virtual environments can be constructed on three axes:

- The spiral approach which allowed users to review and correct their actions in cases of wrong choices (feedback prompt).
- The multi-conceptual design concepts and users’ actions may reinforce a better interpretation of works and actions from all members.
- The management of the complexity through the use and exploitation of multiple modern structures to better understand students’ dynamic interactions.

5. Conclusion

The use of the three-dimensional virtual reality technology is only one component of a nascent complex system, falling in a broader social and educational environment played a key role. It is not just an adjunct issue, but like a part of an educational environment is derived as a candidate platform that enables users to change the whole “status quo” of e-Education. Apparently, the plurality of interactive and multimedia elements described in a
virtual worlds as a nascent learning platform gave users an environment for participatory activities to enhance their human intuitive and kinesthetic interactive communication with others. Beyond the fact that most users enter into these worlds for sharing opinions and ideas with users from all around the world, most of them are also active members of different learning communities and share experiences which in real life could not be easily established.

The articulation of theoretical functions from the implementation of learning activities in a virtual world with cybernetic macro-script for the development of an organizational framework in Open Sim was the main contribution of this research. The idea of using the collaborative Jigsaw teaching technique with the intermediateness of an open source virtual environment was based on the design principles and creation of learning scenarios, which are today so urgent. The Jigsaw technique covered a twofold purpose:

(a) To support and highlight cyber entities' interactions (i.e. between students and instructor) for expanding the interactive participatory active process through their search on information in a virtual world, escaping the traditional weakness created by the lack of an organizational framework of the learning process, in order to handle the complex interactions.

(b) To apply a cybernetic macro-script in an open-ended environment allowed various design-based learning activities, such as Open Sim; thus until now it has not been treated as an educational tool.

The basic principles underlying this teaching technique have shown the trend of repositioning the principles in learning communities, the users’ awareness and personal commitment in an environment dominated by the team’s spirit to find solutions in problem-centered learning situations (Huang et al., 2011; Pellas & Kazanidis, 2012). In contrast to Barkley et al. (2004) study where the Jigsaw technique was characterized by moderate online transferability in 2D educational environments, other researchers (Konstantinidis et al. 2010; Pellas & Kazanidis, 2012) have demonstrated that this teaching technique in virtual worlds can be enhanced through the development of specific virtual tools, easy transferability and functionality (e.g. gestures and visualization tools questions or ideas). This reason was very important for its implementation in the current study.

Until nowadays it has become a major issue on the research field the design of an organizational-practical teaching approach to identify or amplify further the basic skills that students need for better interaction in a pre-constructed virtual learning space (which is considered more complex because of its graphical interface in three dimensions) based not only to its visual environment, but also to the social relationships which emerged within it. In this view, the technological infrastructure of Open Sim considered as a key element of co-presence between students to create opportunities for social interaction, communication and a direct impact on learning achievements (de Lucia et al., 2008; Minocha & Reeves, 2010). Moreover, Dalgarno and Lee (2010) have stressed that the affordances of virtual worlds can replicate the main principles for designing best practices in virtual learning spaces, and the potential educational benefits can be attributed due to the architectural design of each environment. The same researchers also considered the need for further research based on right instructional design which may assist users’ best practices.

Other studies (de Lucia et al., 2008; Papachristos, Vrellis, Natsis & Mikropoulos, 2013) for the same research topic have identified some important findings about the educational benefits in which a virtual learning space can be designed. In these dimensions the concept of the system’s adaptability indicated that the VSM constructs can be adapted in Open Sim with all of its features, but in any case this virtual world should offer more advantages than those given in a traditional classroom. Otherwise, when a virtual learning space is not appropriate and in addition has the outset adapted to the needs and interests of all users for a particular learning objective, it may cause adverse effects.

Based on the above point of view, a second factor that could be emerging from the utilization of Open Sim is the exploration of innovative organizational-teaching plan for understanding educators and scholars the different dimensions of students’ interactions with a view to strengthening their co-presence in a virtual multi-user environment. In an educational context, the sense of place within in a specific context may enhance the learning process.
(Pellas, Peroutseas & Kazanidis, 2013; Semken & Freeman, 2008). Thereupon, a virtual learning space should include a well-structured environment for the student engagement. Through the use of synchronous and asynchronous communication tools Open Sim not only facilities the cooperation and interaction among users, but it offers an ideal environment for various learning tasks. However, all these processes will be as it was described in the current process based on students’ activities through a cybernetic macro-script.

The evolving field of the technological innovation can create multiple artifacts and provides learning opportunities which can contribute to the knowledge management of educators and scholars. Meanwhile, it may change the reason of how people can be adapted to a complex three-dimensional technologically-advanced environment. Students may learn in new learning tasks, acquire new skills and can access to educational resources on a global scale, leading this process to new strategies of learning, beyond statutory and formal contexts. The utilization of knowledge resources - if there are properly well-organized- can improve the students’ performances in virtual environments. In this case, if it is wanted to be deciphered the factors of success in the environment it must meet certain conditions in order to be further recognized its characteristics. These mainly were:

(i) The ease-of-use learning tools for the proper technical and organizational infrastructure of the system in collaborative settings.
(ii) The multiple communication channels that may motivate and help students to adequately collaborate with other peers.

The overall conclusion that this study has shown is the adoption of innovative environments for the knowledge management that can be successfully guided by the principles of a collaborative learning. The facilitation of the knowledge's construction as a collective process, and even more the collective share of its configuration among the members of the group can also be reinforced in these conditions. Regarding to the role of virtual environments in this multi-level shape of collaborative interactions, it is truly necessary to believe that the technical capabilities of the environment can facilitate the construction of shared meanings theoretically and practically. Furthermore, it is worth noting that the participation in a group did not mean that individual representatives can be easily identified with various collaborative phases in Open Sim.

As regards the original findings of a strategic framework for further development like a cybernetic macro-script in conjunction with the Jigsaw technique that it can be structured for the organization of users’ interactions to conquer their innovative knowledge domain seemed at this time an initial effort which can be responded effectively on:

- Making e-learning training sessions and increasing the students’ motivation.
- Improving the quality and effectiveness of e-Education and its training sessions.
- Promoting equity, social cohesion and active citizenship among members.
- Fostering innovation, creativity and entrepreneurship at all educational levels.

To sum up, the present study described a cybernetic macro-script that can bring up a new dimension among cyber entities to elaborate the cybernetic mechanisms of a viable learning procedure in a virtual world. The quality and effectiveness training processes in virtual worlds unveiled by:

(a) Participating students in the development of the social-cultural frameworks that reinforced their social presence.
(b) Generating the innovative knowledge through their involvement in the reflective practice and research held in Open Sim.
(c) Evacuating students’ intrinsic cognitive overload in order to become more autonomous leaders of their professional development.

6. Limitations and future work

Three limitations that should primarily be underlined are as follows:
• It was presented only theoretical foundations of a systemic macro-script with the collaborative technique of the Jigsaw for handling users’ collaborative interactions. Although, it was not measuring the effectiveness of this process.
• It wasn’t considered the internal or exogenous students’ factors or other socio-cognitive constructs (self-efficacy, self-regulation or task value) that may affect students’ participation in a reliable hybrid instructional format according to the proposed model.
• While these theoretical foundations from the proposed cybernetic macro-script might provide some evidence of a significant validity, it still required to be tested more empirically and extensively results from a case study or other empirical study.

Future works may evaluate several educational practices in formative or summative assessment forms to ensure the high quality of this cybernetic learning plan and provide adequately the initial groundwork phases for e-Education. These establishments currently can notably enforce the continuing professional development for instructors and students, making the teaching plan more attractive on transmitting their socio-cognitive skills/abilities. In particular, this problem concerned the production of learning materials and involved the responsibility to ensure the effectiveness of educational activities, both in terms of minimum use of resources that required and completed satisfaction based on students’ needs. Some of the problems associated with this field of research are:

- How optimally limited resources of an educational unit may allow the efficient allocation of activities between users?
- How can a “cybernetic” plan be better prepared to minimize the cost function of e-learning programs?
- How can be better a participatory “cybernetic plan” (i.e. the organization and coordination setting by a number of people) be sufficiently operatedin a valuable learning procedure for the assignment of staff’s responsibilities to become more effective for educational activities through virtual worlds?

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**Figures**

*Figure 1: A brief description of a macro-script for the collaboration of users in Open Sim*
Figure 2: A flowchart of the cybernetic macro-script

A simulated macro-script for organizing the "knowledge field"

- Students start to utilize interactive tools and artifacts.
- The instructor as the facilitator of the learning process encourages students' participation.

The restructuring effects from the primary learning process are conceived, in order to be utilized in the Virtual Reality (VR) technology.

- Contemporary educational models can support an interdisciplinary approach to teaching which is based on the principles of social interaction and co-construction of knowledge.

The recognition of students' ideas is depending on the environment's adoption where they construct a new knowledge field. Moreover, each class period organized by: (a) planning for organizing teaching phases, (b) using more than one "medium" to attract student attention, (c) defining the course directions of teaching activities (with questions, evaluation and ultimate conclusions as to skillfully students' preparation and to find the desired knowledge, no evaluation sheet).

Students' managerial responsibilities must be provided.

VSM processes held in Open Sim

1. The Negotiation process of knowledge includes resources among students and instructor.

2. The Coordination process includes the collection of digital resources among students and instructor.

3. The Monitoring process includes valuable parameters for better handle the students' management in teams by providing the appropriate feedback.

4. The Self-organization process includes the technological infrastructure of a learning platform with its tools that can be included in learning activities.

5. The Personalization process includes the adaptive elements that students need to be engaged.

6. The Adoption process includes the necessary requirements that students and instructors need to be create or reuse a learning platform.

Continuous assessment, review, and improvement of technological innovations that students can implement in the virtual world.

Students should try to store their developments in order to get their project evaluated by other peers.

Description of the knowledge's management through the "jigsaw" technique phases

- Formation, creation, and collection of the visually-rich environment with new elements.
- In-world activities allow students to collect the instructor's information.

- The heterogeneous formation of action groups for designating, collecting data and organizing the major structure of the collaborative learning.
- The pre-analysis phase of the learning task.

- The "assignments of students" refer for the analysis and improvement of data.
- The online critical evaluation students' participation during the collection of the learning material.

(a) Internal critical appraisal
(b) The instructor as the facilitator of the learning process encourage students' participation
(c) Experts' collaboration for the organizational development

(a) Storage of information in the 3D virtual world
(b) Presentation of main knowledge reports from each team.