Educ Inf Technol (2017) 22:939–964
DOI 10.1007/s10639-016-9465-1

Blending the CoI model with Jigsaw technique for pre-service foreign language teachers' continuing professional development using Open Sim and Sloodle

Nikolaos Pellas[1] · **Anna Boumpa**[2]

Published online: 21 January 2016

Abstract This study seeks to investigate the effect of pre-service foreign language teachers' interactions on their continuing professional development (CPD), using a theoretical instructional design framework consisted of the three presence indicators of a Community of Inquiry (CoI) model and the Jigsaw teaching technique. The investigation was performed through a case study with thirty-five (n = 35) teachers who participated voluntarily in three consecutive tasks, by blending Sloodle as a free plug-in via the three-dimensional (3D) multi-user virtual world Open Simulator (Open Sim), with the purpose of creating virtual learning environments. A mixed-method research was conducted to be measured pre-service teachers' engagement, using a validated CoI model questionnaire proposed by Arbaugh et al. (2008) for collecting the quantitative data, and secondly their opinions for participation, achievements, abilities and difficulties, when studying collaboratively with their peers for gathering the qualitative data, after finishing several learning tasks. The study findings indicate that collaborative practice-based tasks in synchronous communication modes, such as group work, team effort, instructor's or peer feedback and consolidated learning material in a 3D multi-user virtual environment have enhanced the learning experience for more meaningful outcomes. The highest mean scores were adequately addressed to the teaching and social presences, indicating that pre-service teachers were enough satisfied due to the easy expression of proposals and the sense of freedom for exchanging ideas/opinions with their colleagues. This study contributes on the fundamental issues of cooperation,

✉ Nikolaos Pellas
npellas@aegean.gr

Anna Boumpa
anna-bouba@hotmail.com

[1] Department of Product and Systems Design Engineering, University of the Aegean, 1 Konstantinoupoleos street, Hermoupolis, GR-84100 Syros, Cyclades, Greece

[2] Secondary Education, 2nd High school of Hermoupolis, Xirokampos, GR-84100 Syros, Greece

socialization, retention and attendance rates rising among teachers' interactions with the respect to empower not only their CPD, but also their management and learning responsibilities, based on the affordances that a 3D technology-enhanced environment can provide.

Keywords Continuing professional development · CoI model · Instructional design framework Jigsaw · Open Sim · Sloodle

1 Introduction

Teachers' continuing professional development (CPD) is defined as the process of maintaining and enhancing knowledge, according to the needs of their personal professionalism that can be provided in several training sessions using digital-oriented environments (Seezink and Poell 2010). CPD is necessary for pre-service teachers, regardless their educational level or discipline, with the purpose to provide alternative options for their information technology literacy. In nowadays, teachers' CPD should include new features rising from the transactions of this contemporary information society, so that the instructional design developments can respond to the demands of tomorrow's educational practices (Cho et al. 2015). Beyond the effectiveness of training activities, pre-service teachers must firstly meet the needs of their new roles in this digital-oriented knowledge and information society. Especially, this option is focused on the development skills and attitudes that may not only make them capable in exploiting innovative digital technologies, but also in understanding their valuable use on a daily basis through the implementation of professional learning tasks (Huang et al. 2011).

According to these perspectives, research points that considered as important should carefully follow a theoretical foundation that can support an instructional design framework, in which the appropriate learning activities can be implemented to gain all teachers easier the learning material and thence enhance their professionalism (Chen et al. 2015). Liu (2005) has opined that pre-service teachers' performance and attitudes towards an instructional planning by using web-based environments were improved significantly, in contrast to the traditional training courses. Thence, it is raised a general belief that an effective collaborative learning process must depend upon the richness and intensity of interactions, in which group members engaged through collaborative activities. While users' interactions as factors affecting a successful collaborative learning climate among users are significant, it is as well as crucial to acknowledge the need for both effective collaborative learning in well-defined instructional contexts and well-designed digital-oriented environments (Dillenbourg and Hong 2008).

The exploitation of innovative educational technologies has caused serious changes in the present educational system. For instance, web-based (2.0) transactions allow users from all over the world to interact cheaply, quickly and reliably in digital communities, using LMS or Massive Open Online Courses (MOOCS), in order to have access in several digital information sources that are used as learning materials. However, the following drawbacks are sometimes observed, especially for foreign language pre-service teachers' CPD: a) lack of teachers' training support in using Web-based sources or transactions (Singhal 1997) and b) lack of technological

infrastructure, regarding the communication tools, which are referred as crucial for users' interaction or participation for knowledge acquisition (Corrêa 2001). According to these dimensions, typical problems that inhibit successful interaction in teachers' online communities, using digital-oriented environments are appeared to be crucial: i) lack of active membership contributions (Macdonald and Poniatowska 2011), ii) lack of trust may inhibit communication among users in online communities (Kling and Courtright 2003) and iii) lack of users' incentives cause failure of understanding the content material and without having assistance of the main instructor or executing successfully other priorities to fulfill (Dennen et al. 2007).

The technological infrastructure of three-dimensional (3D) multi-user virtual worlds can offer several advantages in a learning process. The expansion of these 3D virtual worlds as computer supported platforms, has led to the implementation of pedagogical approaches which provide the knowledge acquisition in a collaborative climate created by users' social interaction and production of learning material in constructivist-oriented instructional contexts (Gregory and Masters 2012). Usually, it can be referred for online and face-to-face (f-2-f) interactions among users as avatars who participate in Computer-Supported Collaborative (Blended) Learning (CSC[B]L) contexts. Of course, such a process includes complex learning situations that endow formal and informal activities, which are conducted at different spatial locations. This interest has been extended also to teachers' CPD and specifically to the instructional and technological capabilities that can offer (Cho et al. 2015; Kallonis and Sampson 2011).

However, users who do not have previous experience with 3D multi-user virtual worlds, cannot accept so easily their usage, due to the cognitive overload that appeared during their first-time entry regarding the variety of information that they should gain in furtherance of participating in different learning activities. Although Dickey (2005) has already noticed that the in-built tools of 3D multi-user virtual worlds present a high-floor (i.e. steep learning curve) hurdle for trainee users to overcome, the utilization of two-dimensional (2D) tools combined with constructivist-oriented learning approaches come to get low these barriers and enhance users' engagement as well. In order to overcome this obstacle, a growing academic literature body (Callaghan et al. 2009; Pellas 2014a) has already suggested alternative opportunities for interactive tasks, by combining the most common-in-use LMS of Moodle, which is defined as a free plug-in module via Second Life or Open Sim, known as Sloodle (Sloodle = Simulation Linked Object Oriented Dynamic Learning Environment). The utilization of open source systems, like Moodle and Open Sim through Sloodle can facilitate and examine the fruitful execution of online courses (Pellas 2015), while issues of online transferability and interoperability that lead to a better understanding of the organizational complexity in collaborative activities need further investigation.

In this demand, several challenges are identified for the reconstitution of a new knowledge domain and the enhancement of pre-service teachers' CPD and technological literacy using candidate learning platforms for supporting online or blended instructional formats. Educators and scholars (Cho et al. 2015; Kallonis and Sampson 2011) have also provided the need to rethink alternative options for the assimilation of the experiential knowledge in (2D) Learning management Systems (LMS) or (3D) multi-user virtual worlds. Considering these situations, it is also a crucial need to establish an alternative approach for instructional designers of foreign language courses

in favor of encouraging them to value their technological literacy that is meaningful for their profession (Matzoukou 2013).

Computer-mediated communication (CMC) which can be defined as the "digital umbrella" of web (2.0)-based transactions, including 3D multi-user virtual worlds, has been firmly used in various training programs to increase users' awareness in blended instructional formats (Kanuka and Anderson 1998). Regarding the use of CMC support to enhance users' learning experience using technologically-advanced environments, Garrison et al. (2000) have developed a theoretical model (or a framework) to allow instructional researchers analyze users' interactions. The CoI model consists of three presence indicators: i) cognitive presence (CP), ii) social presence (SP), and iii) teaching presence (TP). The community of inquiry (CoI) model can assist the construction of knowledge as a result of teamwork among active participants in learning communities, in which: a) they interact with other peers and with the instructor (CP), b) they implement constructivist-oriented scenarios that reflect as an educational plan to an online environment (TP) and c) they try to enhance their socio-cognitive skills in a collaborative climate that can be implemented through online or blended instructional formats (SP).

To cope the dilemma of reducing the instructional-organizational complexity during users' first time entry in a 3D multi-user virtual world that is more complex than in a 2D environment, the Jigsaw teaching technique is regarded as one of the most remarkable techniques that can enhance users' collaboration, because it can efficiently support collaborative learning scenarios (Konstantinidis et al. 2010; Pellas 2014b). To date, foreign language teachers' CPD can be achieved meaningfully, not only by utilizing technologically-advanced environments, but also by implementing learning scenarios in well-designed instructional scenarios (Borg 2003; Wang et al. 2014). Also, an instructional support must be focused on users' interactions, providing the potential of knowledge acquisition in constructivist-oriented tasks for the development of a wide range of interactions (Pellas 2014b). A teaching strategy that can assist users' coordination, is the Jigsaw. This teaching strategy supports the interdependence of all group members, by promoting interaction and cognitive elaboration to all members. To this notion, it can foster the construction of a common knowledge domain of Computer Supported Collaborative Learning (cscl), not only in face-to-face contexts (Hinze et al. 2002), but also in online (Kordaki et al. 2009). The utilization of the Jigsaw technique during a learning process in 3D multi-user virtual worlds for CSC[B]L is necessary for the following reasons (Konstantinidis et al. 2010; Pellas 2014b): (a) it can strengthen the composition of teams, in which users with a specific role can synthesize the knowledge that they gain, by colliding the knowledge's puzzle of each team member in collaborative activities, (b) it can increase each team' s efforts for the final learning outcome in a concrete organizational and pedagogical framework, and (c) the use of this technique in 3D multi-user virtual world can help users improve the conditions of their collaboration and coordination in place of achieving a common objective. Thence, the use of this technique can offer an improved capacity for users to develop interpersonal and interactive relationships, adopting roles resemble to those of reality as each one is modeled in a 3D multi-user virtual world as an iconic figure (avatar) and seemed to be "immersed" with an embodied presence in realistic or at least illusionary conditions (Pellas and Kazanidis 2014a).

However, a study that can integrate CoI model presence indicators (teaching, social and cognitive) into instructional settings via a 3D virtual world and combined with a 2D LMS, has not been conducted yet. Three components of an instructional approach can be combined with Jigsaw collaborative teaching technique, to the amount of contextualizing blended learning and teaching experience by using Open Sim, in combination with Sloodle. This study points out the development, use and assessment of an instructional approach for a community of inquiry to explore the effects of the presence indicators on shaping the experience through online and face-to-face settings, between pre-service teachers and their instructor, providing the following questions that need to be answered:

1. How can the CoI model with Jigsaw as an instructional design framework using Open Sim combined with Sloodle as free-plug in module influence pre-service foreign language teachers' CPD?
2. Which of the three presence indicators (teaching, social and cognitive) can improve pre-service foreign language teachers' learning outcomes in blended a/−synchronous modes?

The proposed instructional design framework based on the CoI model and combined with the Jigsaw teaching technique can exemplify the components in virtual educational groups that are digitally-oriented towards the achievement of learning objectives in communities of inquiry. Regarding to users' collaboration and knowledge acquisition in well-established frames that is always needed, there are several challenges that a learning approach can provide in these circumstances. Efforts to define or standardize the components or mechanisms of collaborative scripts may lead effectively to the creation of a growth-promoting technological literacy of pre-service teachers using this model. The purpose of this study is to investigate the effect of pre-service foreign language teachers' interactions on their CPD, using a theoretical instructional design framework consisted of the three presence indicators of a Community of Inquiry (CoI) model and the Jigsaw teaching technique for the development of virtual learning environments that can be held in Open Sim and Sloodle.

2 Background

2.1 Communities of inquiry

Buraphadeja and Dawson (2008) have suggested three models for the analysis of users' interactions in order to describe educational processes, by utilizing online digital environments (i-the model of content analysis of Newman, Webb and Cochrane, ii-the model of Interaction Analysis of Gunawardena, et al. and iii-the CoI model of Garrison, Anderson and Archer). The CoI model (Garrison et al. 2000) was stated by the same authors as the most appropriate for analyzing users' interactions, because of the following reasons: (a) the relevant literature has recognized the contribution of the CoI model, in terms of creating a valid organizational-pedagogical framework for the investigation of users' interactions in communities (Arbaugh 2004), (b) previous models have only offered the analysis of users' endogenous interactions, but a

theoretical framework for the development not in well-organized instructional contexts, in contrast to Garrison's et al. (2000) model was not identified and (c) the role and purpose of a theoretical framework was not indicated in previous models, in order to describe the context of teaching and learning activities, based on constructivist pedagogical underpinnings (Pellas and Kazanidis 2014b).

Garrison et al. (2000) have developed a theoretical model for the analysis of educational activities in e-learning environments focused on the development of a community of inquiry and it is based on three interrelated presence indicators: CP (content of messages, ideas, arguments and opinions or statements), SP (interaction between members) and TP (sharing roles and initiatives emanating from other peers in collaborative settings and from the instructor). The contextual framework of a CoI model integrated with the above indicators towards to identify students' interactions and relationships in a learning community. Within this framework the construction of knowledge is produced as a result of teamwork between active participants and in this dimension it is reflected as a suitable theoretical framework not only for online 2D digital learning environments (Shea and Bidjerano 2010), but also for 3D multi-user virtual worlds (Pellas and Kazanidis 2014b; Traphagan et al. 2010). The educational-transactional nature of this model have been discussed for more than twelve years within academic research circles. The CoI model refers to the new construction of knowledge in a collaborative climate supposing to achieve deep and meaningful learning outcomes based on a constructivist-oriented theoretical background that can empower users' collaboration (Garrison et al. 2000). The CoI model has been developed to describe in detail the complex users' interactions in collaborative and constructivist-oriented learning processes via electronic (on-line) environments (Garrison 2000).

A CoI model is viewed as an instructional means to study collaborative constructivist-oriented educational transactions in blended or face-to-face settings. Recent research has also delivered the CoI framework as an informing rationale for online instructional design of educational experiences (Shea and Bidjerano 2010). The validated questionnaire of this model can also be used as a rubric (tool for formative evaluation) to measure users' engagement in functioning communities of inquiry (Garrison et al. 2010a). For the purposes of this study, the CoI model is used both as an instructional design means for evaluating the effectiveness of teachers' CPD in synchronous communication modes.

2.2 Related works from the literature

There are many notable studies that have previously implemented the CoI model as a theoretical model via LMS and revealed some other fundamental results: (a) Shea and Bidjerano (2010) have assessed the CoI model in order to describe and explain differences on the users' learning outcomes in hybrid or fully online course delivery methods, (b) Gorsky and Blau (2009) have described the comparison of users' behaviors in blended sessions and (c) Joo et al. (2011) have proved that users' persistent satisfaction in the learning process is regarded as a critical factor for successful online university-level programs. The results have shown that CoI presence indicators are linked with characteristics, such as perceived usefulness and ease –to- use Graphical User Interface (GUI).

The above literature suggests that the CoI model can provide a more comprehensive view for educational researchers, who are capable of identifying or amplifying interactions

among social, cognitive and teaching presences in deep and meaningful learning situations, using digital learning environments (Garrison and Arbaugh 2007; Joo et al. 2011).

On the other side, fewer were the studies that utilized the CoI model in 3D multi-user virtual worlds. McKerlich et al. (2011) have made a first attempt to implement the CoI model in Second Life and they have described an observational study, by using a selected sample for analysis of their interactions. The results were particularly encouraging, according to students' participation; and the community followed a "constructivist-oriented" learning process. Another interesting point of view was nearly proposed by McKerlich et al. (2011) who confirmed that CoI presence indicators in online settings can increase users' performance in Second Life.

In Traphagan et al. (2010) study, the CoI model was used to compare the nature of learning experiences in Second Life and in another text/voice-based learning environment without graphics (TeachNet). By utilizing a mixed method of frequency code and graphic consistency, the results of cognitive codes indicated that students' discussions inside the TeachNet were in high levels, and thus the cognitive presence (CP) was in higher levels than in Second Life.

Lastly, in the pedagogical-psychological perspective, Pellas and Kazanidis (2014a, b) study findings from answers of one hundred thirty-five (135) participants who attended at several online sessions through Second Life, revealed that the situational interest was the only significant predictor of SP.

2.3 Open Sim and Sloodle configuration

Open Sim is open source software that offers high compatibility functionalities with Second Life and the same communication protocols, like mutual 3D multi-user platforms (Ryoo et al. 2011). The "open-ended" architecture of this "world" can be used as a social place for various tasks, such as education, training, and visual prototyping processes. It is pretty remarkable to designate the technological infrastructure of Open Sim that is depicted through the freeware open source server platform, working like the Second Life client viewer (Pellas 2014b). The highest response of Open Sim's functionalities can contribute to the collaboration of distributed students (Pellas 2014c; Ryoo et al. 2011).

Sloodle is a software package which integrates the Moodle web-based virtual learning environment and the 3D virtual world platform of Second Life or Open Sim. It contributes to the combination of Moodle and Open Sim in a blended 3D/web virtual learning environment as a free plug-in. Previous studies (Callaghan et al. 2009; Kemp et al. 2009; Pellas 2014a) have utilized it for different courses as a candidate learning platform for the following reasons:

- Moodle's web-based tools (e.g. Web-intercom, Quiz chair, Registration booth, Toolbar and Presenter etc.) can be used to support in-world classes
- Open Sim can be used to promote users' engagement and immersion in practice-based activities within Moodle's online course activities.

The combination of Sloodle with Open Sim can be defined as a multi-factorial and multi-functional open source virtual learning environment, yet candidate, in which users develop, share usefully, and create desirable tools for supporting education in 3D multi-user virtual worlds, making the knowledge transfer meaningful (Pellas 2014a, b).

The inspiration behind the combination of Sloodle and Open Sim can provide various engaging learning tasks was decided due to (Pellas 2014c; Berns et al. 2013): a) the use of a low-cost persistent virtual environment (i.e. an environment that still exists even when users log out from it and the changes that they have made are permanent) can assist the implementation of different instructional formats (blended/online), b) the technological infrastructure can provide real-time feedback on users' interactions to create and syntax multiple codes in visually-rich or in realistic problem-based learning settings, c) the a−/synchronous communication tools for verbal (VoIP) or non-verbal (IM, text chat, gestures) communication and realistic aesthetics of a 3D virtual grid permit users to be engaged in mimicking to real life situations, and lastly d) the flexibility and adaptability are unique issues of a 3D virtual grid for users to create at the beginning a learning platform, according to their needs or demands (sense of adaptability). This may help them to organize/coordinate their teams and enhance in these circumstances the sense of co-presence and succeed easier common objectives. The 3D virtual server-based virtual world of Open Sim (OS grid) was entirely on a single Open Simulator server (standalone mode) can be supported by Imprudence client viewer (ver. 1.2).

Many research findings (Gamage et al. 2011; Gregory and Masters 2012; Rayner and Fluck 2014) have shown that 3D multi-user virtual worlds are of great value for foreign language courses for the following reasons: (a) can encourage the reflective learning of all group members constructivist-oriented instructional formats; (b) can enhance users' cognitive skills (analysis, evaluation and creation) and higher-order thinking skills in collaborative activities; (c) can promote the change from superficial to deeper learning in order to facilitate the knowledge acquisition process. As a result, 3D multi-user virtual worlds can contribute to the development of technological skills that are cultivated in learning platforms for the implementation of different instructional approaches in foreign language courses, (d) can manage easier inter-student interactions as well as teacher–student interactions, (e) instructors can compare different methods of interaction to enhance pre-service teacher learning and teaching and (f) can present visual realism to provide a 3D perspective of the classroom – ultimately, with aural representation that will match this veracity.

2.4 The combination of Open Sim and Sloodle

A persistent database SQLite supported this study with the assistance of Freeswitch[1] voice server in the interest of promoting verbal and non-verbal communication among members was also used. The standalone mode was kept in order to protect and block away any misbehaving user, but the staff was free to conduct and teleport to other regions, for collecting the appropriate learning material (Fig. 1). As can observed in Fig. 1 below: i) the main instructor was responsible for the progress and time schedule of the entire process, ii) all participants (pre-service teachers) engaged in different activities via Open Sim and Sloodle, and last but not least iii) the main researcher was responsible to create and share the virtual tools or artifacts, which became beneficial, not only for the development of low-cost virtual learning environments, but also for teachers' CPD.

Based on the above, before users' first-time entry, it was necessary to demonstrate all required learning grids for experiential learning. The pre-constructed spaces were

[1] http://opensimulator.org/wiki/Freeswitch_Module

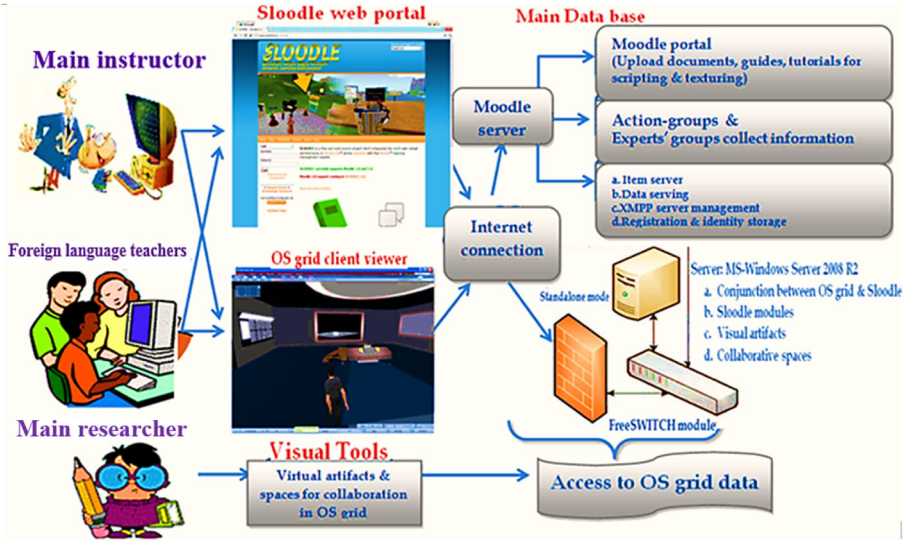

Fig. 1 The architecture function of the connection between Open Sim (OS grid) and Sloodle

important not only for the "life cycle" of a community of inquiry, but also for the successful construction of projects (Pellas 2014b). To this notion, the risks are minimized and interactive applications are produced to enrich users' perspectives. In this phase, four different workplaces are proposed for the knowledge acquisition in a 3D multi-user "open source" virtual world (Table 1):

The main utilization of interactive visual artifacts was imperative to optimize the learning process, so that support pre-service foreign language teachers' activities: a) firstly, to construct low-cost virtual learning environments and implement collaborative learning scenarios into them, based on well-designed instructional formats, and b) secondly, to coordinate and evaluate collaborative tasks based on users' interactions. Open Sim grid in a "standalone" mode, was not equipped with the appropriate tools

Table 1 Virtual workplaces in an Open Sim standalone server

Name of grids in an Open Sim standalone server	Purpose of using virtual grids
The meeting grid	The meeting grid had an ergonomic design for all pre-service teachers, during their first time entrance in order to collaborate with their teammates and utilize Sloodle and Open Sim transactions.
The instructor's grid	The instructor's grid was the virtual environment in which pre-service teachers took feedback and support from the main instructor to create their virtual learning environments.
The collaboration grid	The collaboration grid was designed for all users and it was specifically used to assign all pre-service teachers' roles before the begging of the project.
The simulation grid	The simulation grid was the virtual place in which all teachers learned how to use virtual artifacts and built-in tools of Open Sim in order to collaborate a−/synchronously with other team members to create and design their virtual learning environments.

(apart from these that a client viewer offered) and it was not sufficient as a virtual environment for constructivist learning activities. Figure 2 presents an example of two different virtual learning environments created in Open Sim.

Users should take advantage of the Open Sim grid scripting language (OSSL) or the construction of primary virtual artifacts. Below, Table 2 presents two separated lists. The first is for Sloodle modules and the second for visual artifacts. These tools are to be implemented during the implementation of the CoI model in Open Sim (Table 2).

Many activities have been designed in order to depict ways of collaboration, according to the provided figure (Fig. 3).

3 Method

3.1 Participants

The target-sample of this case study was composed of thirty-five (n = 35) pre-service foreign language teachers (20 female and 15 male). It is also crucial to be mentioned that participants (pre-service foreign language teachers) had different cognitive background and were separated according to their degrees as follows: a) English pre-service teachers (n = 9), b) France pre-service teachers (n = 9), c) German pre-service teachers (n = 8) and d) Italian pre-service teachers (n = 9). The mean age of all students was almost 33 years old (SD = 4.04). All participants were spread across two classes face-to-face and online to increase their CPD. Also, all classes were taught the same material by the same instructor and one researcher, who both guided the entire study and exemplify the CoI model with the Jigsaw teaching technique usage. No one of pre-service teachers had previously been taught how to construct virtual learning environments in 3D multi-user virtual worlds. Of course, there were observed some of them who had prior experience from other courses related with the utilization of digital-oriented environments. Those pre-service teachers were used as "experts" (5 were identified) during the teams' separation.

Before the experiment started, a short survey about the computer background of participants (pre-service teachers) was necessary in order to acknowledge their experience. The results showed that the majority of teachers have used computers for 2 to 4 years (87 %). This finding appeared to be crucial, because pre-service teachers require to know how to study with computers for their in-class lessons. However, fewer (23 %) had experience in using a computer for more than 2 years. Although the majority of

Fig. 2 Two examples of creating virtual learning environments in Open Sim

Table 2 Sloodle modules and virtual artifacts

Sloodle Modules	Virtual Artifacts
Web – intercom. A chat – room can combine Moodle's chat room and Second Life (or Open Sim) text-based chat in order to communicate together all users asynchronously.	Present Board: It is the main board in which users can present their work to other members by uploading JPEG or video files.
Sloodle Registration Booth. One of the most fundamental tasks of Sloodle, is when a user clicks on the registration booth to log in it with his/her avatars's name, while he/she is prompted to visit a Moodle registration page simultaneously.	Sticky Dashboard: This dashboard helps students to stick colored note cards and remember exactly what they need to.
Multi-function Sloodle Toolbar. It includes a range of gestures and it allows the main instructor to get a list of users' name from Moodle to Second Life (or Open Sim)	Interactive touch screen: This in-world screen presents students' machinimas (edting video that present in-world educational activities).
Postcard Blogger. It is an additional plug-in that users have to send photo as "postcard" from Second Life (or Open Sim) and text to other members automatically when they uploaded something in Moodle.	Joystick: It is a multi-touch tool that allow users to simultaneously control two screens, one that they upload machinima video and another one that can be configured according to their daily announcements.
Quiz chair & Pile-on Quiz. The quiz tools assist the instructor to provide quizzes in Moodle and then to present them in the 3D environment.	Light Pen: It is a simple visual highlighting pen that the main instructor uses to write in the announcement board.
QuizHUD: The QuizHUD provides a web-based authoring environment for the creation of educational content in Second Life and a user-interface HUD (Head-up Display). Students can explore custom built-in tools of Open Sim in order to learn about aspects of this environment by clicking on objects or artifacts. Quizzes can be built which include mixtures of multiple choices questions (answered using tabs on the QuizHUD object itself) or questions that can be answered by identifying and clicking on objects in the 3D multi-user environment.	Tablet: Student's tablet is a personal calendar and storage of activities for each teacher. Open Sim grid docs: Almost all pre-service teachers already knew and worked with Google docs, as they wanted to create a source that is connected to the Internet (a "copy-paste" process from the note cards).

teachers (89 %) referred that the use of computer to do a simple desk work (e.g., word processing and Internet use), only 6.93 % knew how to use Web-based transactions, like Moodle. Over 70 % of the participants, neither knew how to write or modify a web-based resource in Moodle, nor they know what a 3D multi-user virtual world could be (95 %). In other words, most of them did not have experience in using Moodle or Open Sim and this project was offered for the implementation of learning scenarios for pre-service foreign language teachers.

3.2 Measurement instruments

The instrument is separated into three subscales consisted of TP (Statements 1–13), SP (Statements 14–22), and CP (Statements 23–34), based on Arbaugh et al. (2008) study. Arbaugh et al. (2008) have determined that the CoI instrument is a valid, reliable, and efficient for the measurement of social and cognitive and teaching presence.

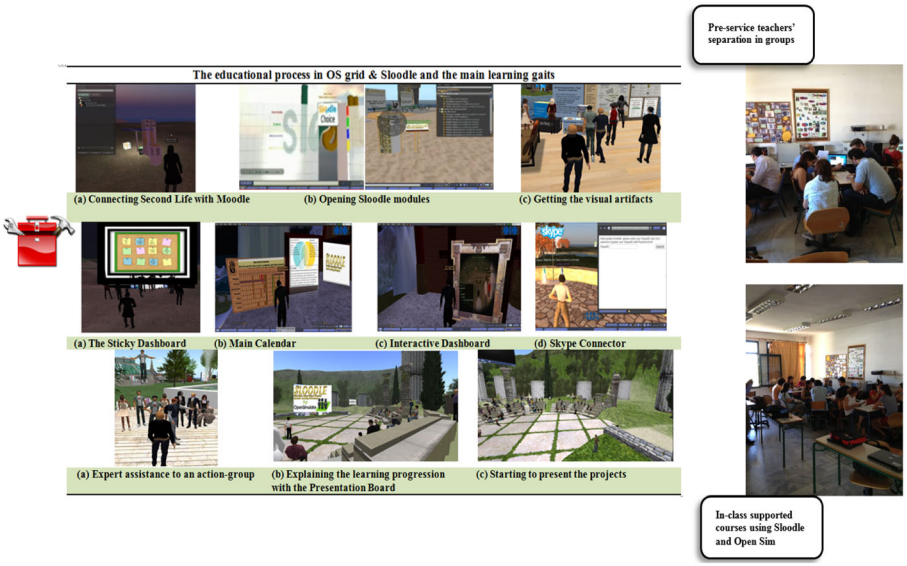

Fig. 3 Virtual learning workplaces and visual artifacts

Furthermore, factor analysis supported the construct of teaching presence, but suggested that one factor related to course design or organization and another factor related to instructor's behavior during the course. The three CoI presence indicators are interconnected and each one of them is hypothesized that can influence the other two. Ordinal responses were scored using a five point (close-ended) Likert scale (1 = Strongly Disagree) to (5 = Strongly Agree) questionnaire. Cronbach's Alpha (*a*) generated internal consistencies of 0.75 for TP, 0.79 for SP, and 0.77 for CP questions respectively.

Online surveys were collected at the end of the project. Nvivo (ver. 10) software was used on a part of aggregating pre-service teachers' answers from the interview (qualitative analysis) as the main collection tool for their participation, achievements, abilities and difficulties, when studying collaboratively with their peers, after finishing several learning tasks. Qualitative data were used to supplement data. The second tool was the statistical program of SPSS (ver. 22) that used for setting up the quantitative data connection, configuration, and creation of templates.

3.3 Study design

The exploration of perspectives of virtual class-supported prototyping in Open Sim, focused on simplified content creation and collaborative reflection in educational aspects for pre-service foreign language teachers' CPD was the main concern of this project's seminar. The research was expanded to include those teachers whose mutual course was "*Computer Science and ICT services for language learning courses*" and who wished to study using alternative instructional design frameworks and candidate learning platforms as a means to facilitate knowledge acquisition by creating virtual learning environments. The course was titled "*Designing collaborative virtual learning spaces and 3D visual prototyping in Virtual Worlds*" and it was focused on the possible

use of "*Collaboration & Design in Learning*" (CDL) processes and results through 3D virtual places and artifacts, which can be useful for a larger group of users in various teaching and learning processes.

The goals were the following: a) pre-service teachers' familiarity with contemporary online 3D virtual reality functions in blended course delivery method associated with the advanced human-computer interface development of interactive applications. This case emphasized on user-centered design experience, evaluation based on user's usability and design experience for a more sustainable constructivist-oriented knowledge edifice; b) the utilization of a CoI model as a means to organize virtual classroom communication that can be combined with the main pedagogical principles of Jigsaw technique, by using an Open Sim standalone server and Sloodle. This effort had a threefold purpose: (i) to offer high quality classroom courses with synchronous communication modes using blended instructional methods and (ii) to ensure the greatest flexibility for the pre-service teachers' CPD using two innovative platforms (iii) to handle the organizational complexity of team-based activities that appears usually after users' first time entry in the a 3D multi-user virtual world and c) the promotion of innovative technological infrastructures for the development of virtual learning environment that promote users' collaboration.

A mixed-method research approach for educational purposes was utilized and it considered with a legitimate, standalone research design (Creswell et al. 2003). The same authors have defined this type of research method as a mix of both quantitative and qualitative data in a single study in which data collected concurrently (Jick 1979). The reasons of combining quantitative and qualitative data are as follows: a) to bring the strengths of research forms in favor of validating results from a case study; b) to enrich the study results in ways that one form of data does not allow; and last but not least; c) to design a mixed method that can be used to combine different, but complementary data that otherwise may be neglected or lacked by a single one method. This method research was used for this study in the direction of examining instructors' perceptions regarding their engagement by using a CoI model combined with Jigsaw as a theoretical instructional design framework for enhancing pre-service teachers' interactions and thence their CPD. The validated 34-item CoI model survey that is proposed by Arbaugh et al. (2008) was utilized in order to collect data has been found useful for studying in hybrid course delivery settings, particularly significant for understanding the complex and dynamic relationships among the TP, SP and CP.

The qualitative data gathered from pre-service teachers' answers from the interview process were conducted in order to be checked the collected data and thence all questions were started with respect to be measured pre-service teachers': (a) overall experience and evaluation of all sub-units of these lessons, (b) learning outcomes and achievements, and (c) abilities and difficulties, when studying collaboratively with their peers.

3.4 CoI model as an instructional design framework

In this study, a CoI model according to three presence indicators combined with Jigsaw technique as an instructional design framework is proposed. SP was implemented initially from pre-service teachers to create their virtual learning environments (grids), by utilizing visual artifacts of Sloodle and Open Sim to exchange their ideas, opinions,

comments or questions. Interaction among pre-service teachers was encouraged through team-based presentations of their works and weekly Sloodle postings required responses to other virtual class members. Throughout in-world (Open Sim) team-based presentations, four to five pre-service teachers seek to investigate via face-to-face and online tasks, required a collaborative study using a/−synchronous communication tools. Participants needed to investigate the best way that online mapping applications might be useful for learning and final products were shared with the class on basic Moodle web page. All were requested to use as more tools as possible to prepare their plans more effective. The three presence indicators of the CoI model were utilized, according to the following separation:

a. CP was used to promote through challenging and appealing collaborative tasks and communication among users. On the Sloodle page, each team described three applications, the personal benefits of using each program, and how these could help in different content areas of instruction. Weekly Sloodle postings related to pre-service teachers' ideas or opinions were identified. At the end, pre-service teachers were asked, "*What is your opinion about the virtual classroom*?" *What are the potential benefits or/and challenges that might that existed during the learning process*?" Pre-service teachers were assigned as different partners each week to respond to class members' blog posts.
b. TP was established by organizing each task into easily-accessible weekly learning section in face-to-face and online settings that were announced through Sloodle. Other links included the main instructor's feedback, technical help, weekly notes and a/−synchronously communication tools.
c. SP was promoted by asking in each task all pre-service teachers to create their own page in Sloodle and through the discussion board, the main instructor and class members carried on a dialog about their personal achievements. Introductory activities were intended for those pre-service teachers who want to gain familiarity with their peers and with the main instructor. Instructions were given in each week's course work and two questionnaires (one open-ended for interview and one for the measurement of the learning process based on a validated CoI close-ended questionnaire) for formative evaluation were provided.

Each presence is responsible for a specific instructional aim involving various types of learning activities with intended instructional effects (see Table 3).

The CoI instructional design approach is comprised of three instructional components derived from the teaching, social and cognitive presences. These components were postulated to guide the content to be presented or demonstrated, direct the establishment of the peer communication atmosphere and inform the discourse that would facilitate students' participation in the blended synchronous mode.

3.5 The structure of sessions

3.5.1 First session (social presence)

SP coding scheme has three categories: affective, open communication and group cohesion. SP enounced as the online discourse this promotes affective cohesion,

Table 3 The intended instructional effects of the three presence components

Coding scheme of a CoI model	Presence indicators	Instructional phases	Collaborative learning	In-class (face-to-face) and online learning modes
Teaching presence	Instructional management Building understanding Direct instruction	- Assigning students' roles with the learning material in Open Sim - Introduction to the learning activity - Instructors' familiarization with the l earning task	- Team discussions of exercises and practices - Team-based problem-solving exercise in each team are provided	- Open discussions to share or propose solutions to a problematic learning situation - Project formative assessment - The main instructor should conducted with team members regardless the different modes in which he/she attended (online or face-to-face)
Social presence	Emotional expression Open communication Group cohesion	- Team-based conversations and decision that should be provided in the learning task - Introduction to the main collaborative script - Formalization of instructions in teams (separation of team members and experts)		
Cognitive presence	Triggering events Exploration Integration Resolution	- Decision processes based on instructors' solutions - Back to the main group and initial results presentation to other team members - Team's report presentation to the entire virtual class		

dimension relating to the degree of the interpersonal contact and interaction in the class. The researcher's role was to structure the collaborative script and observe pre-eservice teachers' intervention to provide feedback when it was necessary. Shea and Bidjerano (2010) have characterized it as an "*important mediator*" of the relationship among students' perceptions of TP and their evaluation of the learning procedure (Table 4).

3.5.2 Second session (teaching presence)

As Garrison et al. (2000) referred, TP construct sets a task such as design, organization and discourse facilitation between instructor and students (Table 5). The scheme contains three categories: The first category, "design and organization" represents one of the three core teaching responsibilities: establishing curriculum content, learning activities and timelines. The second category, "facilitating discourse" relates to the monitoring and management of purposeful collaboration and reflection. Finally, the third category, "direct instruction" ensures that the community reaches the intended learning outcomes, by diagnosing needs and providing timely information and direction.

3.5.3 Third session (cognitive presence)

CP describes the core of the constructivist-oriented learning process. The scheme has four categories: triggering event, exploration, integration, and resolution. All of them represent the phases of an inquiry process in a collaborative learning environment. In any occasion of the above process, it's crucial to depict the seminar sessions in the following figure, as an attempt of progress (Table 6).

Table 4 Instructional phases based on social presence

Methodological framework for organizing the social presence	Collaborative learning gaits	Collaborative script
a. Expression of emotions and self-disclosure b. Continuing a thread, asking questions or providing agreements c. Pre-construction of team-based activities d. Information and first permission to separate members with the Jigsaw technique Open Sim tools: voice call, IM, chat text, note cards Sloodle modules: Registration booth, multi-functions toolbar Virtual artifacts: Presentation board, sticky board Estimated time horizon: 2 weeks/4 days/3 h of exercise	a. Familiarize pre-service teachers with open Sim b. Creating a climate of collaboration and mutual acceptance of members who will attend in this project. c. The main instructor gives information about the structure, methodology and content of the course Recognition of the idea that learning is constructed on "situated" through various collaborative settings.	a. All members of pre-service teachers should create their profile with personal information. b. Learning e-skills to create web-pages in Sloodle and using artifacts of Open Sim c. Overview of the organizational structure for the creation of a virtual learning environment

Table 5 Instructional phases based on teaching presence

Methodological framework for organizing the teaching presence	Collaborative learning gaits	Collaborative script
a. Design and organization b. Facilitating discussion c. Direct intervention d. Beneficial formalization of the pre-service teachers Open Sim tools: voice mail, IM, chat text, note cards Sloodle modules: Registration booth, multi-function toolbar Virtual artifacts: Presentation board, sticky dashboard, Joystick, light pen Estimated time horizon: 2 weeks/4 days/3 h of exercise	a. Identification of the scope, content section, requirements to develop a virtual prototype learning environment. b. The analysis of the pedagogical principles of the collaborative progress. c. Initial presentation of the project based on teachers' interactions and virtual artifacts usage.	a. Analysis of the environment and identifying using metaphors and affordances of hyper-media in Open Sim. b. Exploitation of virtual artifacts. c. The creation of an instructional plan for a collaborative process focused on pre-service teachers' needs.

4 Results

All pre-service teachers took part in all instructional processes. Most of them had at a middle level proficient to the ICT usage ($M = 2.43$); however according to their answers technological literacy skills seemed to be increased after their attendance to this project ($M = 4.81$). Sloodle and Open Sim usage were two of the most engaging tasks for participants.

Quantitative data that collected from this questionnaire were sent to participants via email and qualitative data from Open Sim were recorded digitally. It was also needed to be conducted with the main instructor and the researcher who both attended in this study daily. According to their approval, the authors posted the recruiting letter and link to the online survey on a message board of Sloodle. All pre-service teachers filled out the online consent form, they were directed to fill out the online survey.

Data were gathered from all participants who invented into "blended" courses in a Greek Institute of Technology (face-to-face) and Open Sim (online) in specific time schedule. All correspondents had a prior contact with the processes of learning-through LMS and especially with Moodle. Throughout the design and operation of a virtual learning community, pre-service teachers aimed at creating a (virtual) learning space through practice-based collaborative activities. The constitution is an attempt of "formalizing" ideas, opinions and requirements, relating to the completed courses and operational characteristics of the environment which took advantage of Open Sim (Table 7).

As it was indicated by high mean scores of all three presences within the course, the CoI model also was a viable means for community's cohesion in a blended educational technology course. The contribution of a CoI model combined with Jigsaw is that it can

Table 6 Instructional phases based on cognitive presence combined with the Jigsaw technique

Methodological framework for organizing activities based on cognitive presence	Learning gaits using Jigsaw	Collaborative script
Triggering event a. Identification and development of the goal b. Starting point, teachers' questions and interaction in Open Sim with the researcher and the main instructor c. Taking decision for the implementation of the learning scenario Open Sim tools: voice call, IM, chat text, note cards Sloodle modules: Registration booth, multi-function toolbar Virtual artifacts: Presentation board, sticky dashboard, Joystick, light pen Estimated time: 2 weeks/3 days/3 h of exercise	[J1] Collection of learning materials from the main instructor's information Formulation and reflection of the division including: a. The main objective to highlight the need of planning and developing educational material in virtual formations b. The collection of information and thereafter the negotiation of the new information that can lead to the knowledge acquisition	a. Starting the modeling phase: After the negotiation phase, the main goal was to resolve problematic situation, focusing on realistic framework for action. b. Group-based conversation. After this demonstration, a specific situation should be implemented within this framework, letting all members to report their ideas.
Exploration phase a. Settlement and division of courses in a community of inquiry b. "Knowledge transfer" to all members c. Exchanging ideas, view and experiences d. Preparation and proposals with initial findings	[J2] Creation of small teams from 5 to 10 members. Each "expert" was chosen according to his/her abilities and technological capabilities [J3] Assigning roles for each member	a. Self-directed learning: All members should begin to manage their responsibilities in order to construct their knowledge field. b. Generalization of initial findings c. Formulating ideas of each team members. d. The pre-analysis phase
Integration phase a. Formation of each group ideas b. Sending a common message about the construction of a virtual place c. Connection of the main components of ideas d. The creation of a solution to a problem	[J4] Constructing specific groups in a common place to exchange ideas. [J5] Specification of learning objects that experts must transfer to other colleagues. The assignment of roles: Members should emerge to redefine the specific goals in the design and development axes of the material. a. Construction of virtual prototypes using artifacts and ideas or views of all pre-service teachers.	a. Continuous evaluation and review for the enhancement of technological capabilities that a virtual learning environment should provide b. Starting to create a fading scaffolding workflow: Eventually all experts of all teams should begin to move away based on the learning

Table 6 (continued)

Methodological framework for organizing activities based on cognitive presence	Learning gaits using Jigsaw	Collaborative script
	b. Internal critical appraisal: This is an attempt to express all elements with the parameters (e.g. functional, aesthetic etc.) that can be connected to the final distribution of the learning materials.	
Resolution phase a. Representative application in realistic contexts b. Test solution c. Conclusion	[J6] Experts must return to action groups. [J7] Evaluation effort in collaborative settings Composition is the key element to gain knowledge of how to create a virtual learning environment	Collaboration among experts for the organization and development of the learning material that is aggregated from other team members. Critical evaluation: All gained information should be evaluated by all experts Compilation of knowledge fairs and reports about the prototype projects. These reports are presented for evaluating the collaborative process in Open Sim

Table 7 Pre-service teachers' demographic characteristics

Questions	Scale of response categories	Results (M, SD)
In how many programs following a hybrid course delivery method did you attend previously, besides this one?	1–4 (programs)	M = 1.77
Please rate your technology literacy at the beginning of this virtual class?	Not very proficient =1 Expert =5	*M* = 2.43
Please rate your technology literacy at the end of this virtual class?	Not very proficient =1 Expert =5	*M* = 4.81
Which exercises and assignments were engaging for you? (you can select more than 2 answers)	Overview of ICT; LMS usage; Game-like environments/Simulations; Social Media & Educational opportunities; Virtual class design	Overview of ICT = 32 LMS usage = 10 Game-like environments/Simulation = 8 Virtual class design = 5
Which do you prefer most, a course that requires Collaborative/interactive exercises or one that can implemented personally without other assistance?	Collaborative =1 Personally =5	*M* = 2.27

offer to each participant specific roles for different actions that might tend to make a course more engaging (e.g., organization of course, facilitation, affective expression, group cohesion, exploration, resolution) in order to obtain a common goal. In addition, each CoI model presence indicators can inform the main instructor about the strengths and weaknesses of online and face-to-face instruction that can be used to improve a course using Open Sim and Sloodle.

Study results have provided evidence that the main instructor assisted pre-service teachers more than adequately to achieve their tasks following the three presence indicators of TP by incorporating clear course structure, strategies to construct a community climate giving feedback, explicit guidance on discourse and assignment completion. By providing different strategies so as to enhance SP, teachers' affective expression and group cohesion was provided. Both could be advantageous specifically for participants who are fearful about communicating their thoughts or ideas directly to other members during a learning process. With new modes of a/−synchronous communication and collaboration using Open Sim with Sloodle and the capability to learn anytime and anywhere, pre-service teachers had the responsibility of making something personal to become familiar to other members of the learning community (Garrison & Cleveland-Innes 2005).

The most distinctive characteristics for the TP (M = 4.28, SD = 0.48) have shown participants' acceptance at high levels (M = 4.44, SD = 0.58) and specifically this distinction was based on the main instructor's assistance who: a) provided clear instructions via a−/synchronous communication channels on how to participate in course learning activities (Q3, M = 4.01, SD = 0.44); b) communicated clearly with all participants to complete specific learning processes with other members important due dates/time frames several learning activities (Q4, M = 4.22, SD = 0.32); c) guided each virtual team towards understanding course topics in a way that helped participants

to clarify their personal thinking (Q6, $M = 4.34$, $SD = 0.47$) and encouraged to explore innovative concepts (Q9, $M = 4.55$, $SD = 0.11$).

According to SP indicators ($M = 3.54$, $SD = 0.24$), students finally gained a sense of belonging in the course, following a blended course delivery method (Q14, $M = 3.22$, $SD = 0.47$) and it was indicated that Open Sim combined with Sloodle could become a candidate learning platform for users' social interaction (Q16, $M = 3.21$, SD = 0.74). Pre-service teachers felt comfortable disagreeing with other peers in courses, despite the sense of trust maintaining to be typically at high levels (Q20, $M = 4.84$, $SD = 0.66$). Discussions in face-to-face or online settings helped them also to develop something meaningful in a collaborative climate (Q22, $M = 4.72$, $SD = 0.12$).

Based CP indicators ($M = 4.59$ $SD = 0.77$) problem-based learning activities increased teachers' interest and participation in courses (Q23, $M = 4.36$, $SD = 0.87$) and brainstorming (text-based or oral) for the knowledge acquisition in both platforms assisted them to resolve content materials as well (Q27, $M = 4.29$, $SD = 0.17$). Learning activities helped also pre-service foreign language teachers to construct more reliable explanations/solutions (Q30, $M = 3.68$, $SD = 1.11$). Reflection on course content and discussions were easier in Open Sim combined with Sloodle and they understand fundamental concepts (Q31, $M = 3.55$, $SD = 0.47$). Pre-service foreign language teachers have developed solutions to course problems that can be applied in practice (Q33, $M = 3.47$, $SD = 1.78$).

Results from the open-ended questionnaire (qualitative data) are provided in Table 8 below.

The results revealed that the TP effect is prominent and correlated with the SP and CP in the context of this study was consistent to previous studies (Akyol and Garrison 2008; Shea and Bidjerano 2010) that TP played a significant role in the three presences of the CoI model. The instructional effects of all three presences in the CPD drawing course designed for blended synchronous mode in the CoI model may not differ from Garrison et al. (2010a) study of the relationships among the three presences. Despite the different results, pre-service foreign language teachers can flexibly construct their knowledge field in more interactive learning activities, enhance online/face-to-face instructional settings or inspire students' inquiry to even out the effects of the three presences.

Secondly, the results also replicated that the instructional roles of all presence indicators are not balanced equally during all learning and teaching processes. Although the results are positive and can affirm the above coherent understandings based on the CoI model as theoretical foundation of a constructivist-oriented instructional approach, the prominent instructional role of the main instructor to the entire study seemed to be really helpful.

5 Discussion and conclusion

Users' engagement in a community is considered as a really difficult task, when they dedicated considerable time to make a remarkable effort, so that facilitate their actions in 3D technologically-advanced environments (Pellas and Kazanidis 2014a). The successful development of a learning process is directly related with users' persistent engagement, in order to understand the learning material that is given based on the

Table 8 Pre-service teachers' answers in the interview

CoI presence indicators	Qualitative findings
Social presence	"As I was attended to all in-world (Open Sim) activities, I recognize that I understood the feeling of co-presence in a virtual learning environment, in which I believe that I enhance my creativity, and problem-base skills to solve any situation that appeared during the learning process. The CoI combined with Jigsaw has affected our team cohesion and collaboration at high levels. The production of a virtual learning grids was initiated with excellent design and planning by the facilitating role of the main instructor. The teaching presence provided solid direction, but also allowed the students the flexibility to become explorers in the quest for new knowledge." "The feeling of being member of a community and collaborate with others to complete a task in Open Sim and then to upload our digital workshops to review others our work was the most interesting part of this project. Responding to others' exercises in Moddle weekly assisted me personally to get know others. It felt very close to a virtual classroom, especially, since as a team met each other in Open Sim."
Teaching presence	"It is truly important to acknowledge the facilitating role of the instructor during the learning process. The goal of creating courses following a blended course delivery method and using innovative platforms (Open Sim and Sloodle) have structured a collaborative climate in the virtual class." "The instructor in the same place and in real time seek to follow up with questions, asking for clarifications according to instructors' thoughts, posts, assignments, as well. This pedagogical practice builds an online learning community." "The course was well-established and easy to follow through Sloodle and Open Sim. Due appointments were always posted and questions about completing assignments were executed adequately every week.
Cognitive presence	"Due to a collaborative climate that was created I felt empowered in this class, especially when everyone was attended to complete in-world activities." "I enjoyed the entire challenge and more specifically when as a team we exchanged opinions and ideas to propose a solution in Open Sim. I appreciated the fact that you let us explore and find the information on our own and present it the way the group decided.

main instructor's support/feedback, so that they succeed common objectives in collaborative settings (Rovai 2002).

Therefore, it is always necessary to be established an instructional framework that can provide: (a) clear contexts in a learning process that describe users' actions, based on constructivist-oriented pedagogical background for establishing their own framework in a 3D web-based virtual environment. This helps in understating how users can approach the learning material within a community of inquiry (Shea and Bidjerano 2010) and (b) through the development and construction of a community of inquiry in well-defined instructional design contexts, it should be taken into account the social, cultural and cognitive dimensions of knowledge acquisition (Sing and Khine 2006). Hence, a further investigation of factors is needed affecting the substantial presence and user's engagement in a community during their participation in collaborative activities to the amount of gaining knowledge easier.

The significance of this study is rising from two major concluding remarks that can answer to the apparent and urgent need for the introduction of an instructional design framework. Firstly, by combining CoI model and Jigsaw technique as constructs of an instructional design framework for teachers' CPD to reduce the organizational-

pedagogical complexity and it is necessary for the appropriate management responsibilities of each user. Secondly, by blending Sloodle with Open Sim, the elimination of the technological-functional boundaries. The exploitation of this model can be very important for foreign language instructors' CPD through the use of technologically-advanced environments. This process can help instructional designers create and use efficiently "hybrid" virtual learning environments. While hardly any study exists to bearing a resemblance to the researcher's intentions, this study findings can possibly contribute to the creation of 3D virtual learning environments that can reduce the "steep learning curve" of teachers who did not have previous experience. Indeed, the organizational-instructional framework that is proposed in this study can also add a value in the literature, due to its prescriptive and complementary nature for the creation of virtual learning environments. The study contributes in contrast to other descriptive studies (Garrison et al. 2000; Shea and Bidjerano 2010), providing alternative options for knowledge acquisition using an instructional framework that consisted of Jigsaw and CoI model presence indicators.

The added value of learning in a community of inquiry in which users can be trained by using the combination of 2D and 3D technologically-advanced environments have noteworthy features that can facilitate the formation of a collaborative climate and organization of information with rich multimedia content. This considered as an extremely encouraging for practical implications, regarding the instructional support for collaboration. While the main analyses referred to the simple transaction of a CoI model, this study seeks to identify and pronounce an innovative instructional framework to support synchronous communication modes in blended instructional formats. The success of a community in this case is multi-factorial and is based on collaboration, communication and commitment among its members and the facilitating role of the instructor to be crucial for the success of such a process as well.

From an instructional point of view, the proposed CSC[B]L for CPD using 3D multi-user virtual worlds seemed to support a constructivist-oriented learning processes, which can be achieved by three interrelated presence indicators of the CoI model. Also, teachers' participation in problem-based activities included a critical examination of practices that involve them to develop comprehensive aspects in order to increase their achievements. This can pass through the cultivation of their personal relationships with their colleagues, but also can be created among users who feel members of a community learn or expect to learn in a collaborative climate. It should be noticed that the co-construction of online communities is a significant parameter for enhancing pre-service foreign language teachers' satisfaction and reducing feelings of isolation between them, especially in online courses. Although, there appeared some scholars (Garrison et al. 2010b; Shea et al. 2009; Swan et al. 2009) who considered the necessity of meaningful learning processes in communities, the present study suggests a practical instructional point for CPD based on the utilization of the CoI model in Open Sim and Sloodle for the implementation of constructivist-oriented learning for teachers' CPD.

The study findings also demonstrate an interesting issue for pre-service teachers' CPD depending to their technological literacy enhancement. Inevitably, instructional designers and pre-service foreign language teachers should start to consider and focus their attention on the affordances in blended synchronous modes. The CoI model combined with the Jigsaw teaching technique as a theoretical framework to organize

a virtual class using Sloodle and Open Sim, seemed that: (a) can support the pre-service teachers to broaden their search on connecting innovative technologies for their CPD, escaping from the conventional instructional approaches of lecturing, searching and creating web-based platforms; (b) can conduce to the utilization of Sloodle and Open Sim as a virtual learning environment, which can be adapted according to the technological infrastructure that depends on the interests and needs of pre-service teachers. It is not limited to its use in real class, but also outside of it (online courses); and (c) can promote online collaborative activities for creating learning virtual learning environments by teachers who have the right conditions and opportunities to develop virtual learning platforms for foreign language courses.

5.1 Limitations

Some of the most notable limitations are as follows:

(a) The present study was deployed in blended instructional methods that held in Open Sim combined with Sloodle, in which the main instructor's feedback was daily and
(b) Pre-service teachers' characteristics may differ from other countries, and the results of this study cannot be generalized so easily.

Compliance with ethical standards

Funding This study was not funded by anyone.

Conflict of interest The authors declare that they have no conflict of interest.

References

Akyol, Z., & Garrison, D. R. (2008). The development of a community of inquiry over time in an online course: Understanding the progression and integration of social, cognitive and teaching presence. *Journal of Asynchronous Learning Networks, 12*(2–3), 3–22.

Arbaugh, B. (2004). Learning to learn online: a study of perceptual changes between multiple online course experiences. *The Internet and Higher. Education*, *7*(2), 169–182.

Berns, A., Gonzalez-Pardo, A., and Camacho, D. (2013). Game-like language learning in 3-D virtual environments. *Computers and Education, 60*(1), 210–220.

Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Language Teaching, 36*(2), 81–109.

Buraphadeja, V., & Dawson, K. (2008). Content analysis in computer-mediated communications: analyzing models for assessing critical thinking through the lens of social constructivism. *American Journal of Distance Education*, *22*(3), 130–145.

Callaghan, M. J., McCusker, K. A., Lopez Losada, J., Harkin, J. G. and Wilson, S. (2009). Teaching engineering education using virtual worlds and virtual learning environments. International Conference on Advances in Computing, Control, and Telecommunication Technologies (pp. 295–299). New Delhi.

Chen, Y. H., Jang, S. J., & Chen, P. J. (2015). Using wikis and collaborative learning for science teachers' professional development. *Journal of Computer Assisted Learning*. doi:10.1111/jcal.12095.

Cho, Y., Yim, S. & Paik, S. (2015). Physical and social presence in 3D virtual role-play for pre-service teachers. The Internet and Higher Education, 25(1), 70–77.

Correa, D. M. (2001). New technologies in teaching and learning English. In M. B. Fortkamp, & R. P. Xavier (Eds.), *EFL Teaching and learning in Brazil: theory and practice* (pp. 211–222). Florianópolis: Insular.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori, & C. Teddlie (Eds.), Handbook of mixed methods in social and behavioral research (pp. 209–240). Thousand Oaks, CA: Sage.

Dennen, V., Darabi, A. & Smith, L. (2007). Instructor–Learner Interaction in Online Courses: The relative perceived importance of particular instructor actions on performance and satisfaction. Distance Education, 28(1), 65–79.

Dickey, M. D. (2005). Brave (new) interactive worlds: A review of the design affordances and constraints of two 3D virtual worlds as interactive learning environments. *Interactive Learning Environments*, *13*(1–2), 121–137.

Dillenbourg, P., & Hong, F. (2008). The mechanism of CSCL macro scripts. *International Journal of Computer-Supported Collaborative Learning*, *3*(1), 5–23.

Gamage, V., Tretiakov, A., & Crump B. (2011). Teacher perceptions of learning affordances of multiuser virtual environments. *Computers & Education, 57*, 2406–2413.

Garrison, D. R. (2000). Theoretical challenges for distance education in the 21st century: A shift from structural to transactional issues. *The International Review of Research in Open and Distance Learning, 1*(1).

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education model. *The Internet and Higher Education, 2*(2–3), 87–105.

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education, 13*(1–2), 5–9.

Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education, 10*(3), 157–172.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *American Journal of Distance Education, 19*(3), 133–148.

Garrison, D. R., Cleveland-Innes, M., & Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *The Internet and Higher Education, 13*(1–2), 31–36.

Gorsky, P., & Blau, I. (2009). Online teaching effectiveness: A tale of two instructors. *International Review of Research on Open and Distance Learning, 10*(3), 1–27.

Gregory, S., & Masters, Y. (2012). Real thinking with virtual hats: A role-playing activity for pre-service teachers in Second Life. Australasian Journal of Educational Technology, 28(3), 420–440.

Hinze, U., Bischoff, M. & Blakowski, G. (2002). Jigsaw method in the context of CSCL. In: Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications (Vol. 1), 789–794.

Huang, K., Lubin, I. A. & Ge, X. (2011). Situated learning in an educational technology course for pre-service teachers. Teaching and Teacher Education, 27(8), 1200–1212.

Jick, T. D. (1979). Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly*, *24*, 602–611.

Joo, Y., Yon Kim, K., & Kyung Kim, E. (2011). Online university students' satisfaction and persistence: Examining perceived level of presence, usefulness and ease of use as predictors in a structural model. *Computers & Education, 57*, 1654–1664.

Kallonis, P. & Sampson, D. (2011). A 3D Virtual Classroom Simulation for supporting School Teachers' Training based on Synectics - 'making the strange familiar. *In Proceedings of the 11th IEEE International Conference on Advanced Learning Technologies* (ICALT 2011). Athens, Georgia, USA, IEEE Computer Society.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *The Journal of Distance Education, 13*(1), 57–74.

Kling, R., & Courtright, C. (2003). Group behavior and learning in electronic forums: A sociotechnical approach. *The Information Society*, *19*(3), 221–235.

Kemp, J., Livingstone, D. & Bloomfield, P. (2009). SLOODLE: Connecting VLE tools with emergent teaching Practice in Second Life. British Journal of Educational Technology, 40(3), 551–555.

Konstantinidis, A., Tsiatsos, Th., Terzidou, Th. & Pomportsis, A. (2010). Fostering collaborative learning in second life: metaphors and affordances. Computers & Education, 55(2), 603–615.

Kordaki, M., Siempos, H., & Daradoumis, T. (2009). Collaborative learning design within open source e-learning systems: lessons learned from an empirical study. In G. Magoulas (Ed.), E-Infrastructures and technologies for lifelong learning: Next generation environments (pp. 212–232). IDEA-Group Publishing.

Liu, T. C. (2005). Web-based Cognitive Apprenticeship Model for Improving Pre-service Teachers' Performances and Attitudes towards Instructional Planning: Design and Field Experiment. *Educational Technology & Society*, *8*(2), 136–149.

Martzoukou, K. (2013). Empowering information literacy and continuing professional development of librarians: new paradigms for learning and practice. *Worldwide Commonalities and Challenges in Information Literacy Research* (pp. 647–654). Springer International Publishing.

Macdonald, J., & Poniatowska, B. (2011). Designing the professional development of staff for teaching online: an OU (UK) case study. *Distance Education, 32*, 119–134.

McKerlich, R., Riis, M., Anderson, T., & Eastman, B. (2011). Student perceptions of teaching presence, social presence, and cognitive presence in a virtual world. MERLOT Journal of Online Learning and Teaching, 7(3), 324–336.

Pellas, N. (2014a). Open source virtual worlds for e-learning. In M. Khosrow-Pour (Ed.), *Encyclopedia of Information Science and Technology* (pp. 7538–7547). Hershey, PA: IGI Global.

Pellas, N. (2014b). A cybernetic framework to articulate the organizational complexity of users' interactions with the Jigsaw technique in an Open Sim standalone server. *International Journal of Innovation and Learning*, *17*(3), 326–358.

Pellas, N. (2014c). The influence of computer self-efficacy, metacognitive self-regulation and self-esteem on student engagement in online learning programs: Evidence from the virtual world of Second Life. *Computers in Human Behavior*, *35*(1), 157–170.

Pellas, N. (2015). Bolstering the quality and integrity of online collaborative courses at university-level with the conjunction of Sloodle and Open Simulator. *Education and Information Technologies*. doi:10.1007/s10639-014-9365-1.

Pellas, N., & Kazanidis, I. (2014a). The impact of computer self-efficacy, situational interest and academic self-concept in virtual communities of inquiry during the distance learning procedures through Second Life. *World Wide Web Journal*, *17*(4), 695–722.

Pellas, N., & Kazanidis, I. (2014b). Online and hybrid university-level courses with the utilization of Second Life: Investigating the factors that predict student choice in Second Life supported online and hybrid university-level courses. *Computers in Human Behavior*, *40*(2), 31–43.

Rayner, C., & Fluck, A. (2014). Pre-service teachers' perceptions of simSchool as preparation for inclusive education: a pilot study. *Asia-Pacific Journal of Teacher Education*, *42*(3), 212–227.

Rovai, A. P. (2002). Sense of community, perceived cognitive learning, and persistence in asynchronous learning networks. *The Internet and Higher Education, 5*(4), 319–33.

Ryoo, J., Techatassanasoontorn, A., Lee, D. & Lothian, J. (2011). Game-based Infosec education using Open Sim. *In Proceedings of the 15th Colloquium for Information systems security Education*. Ohio.

Seezink, A., & Poell, R. (2010). Continuing professional development needs of teachers in schools for competence-based vocational education. *Journal of European Industrial Training*, *34*(5), 455–474.

Sing, C. C., & Khine, M. S. (2006). An analysis of interaction and participation patterns in online community. *Educational Technology & Society, 9*(1), 250–261.

Singhal, M. (1997). The internet and foreign language education: Benefits and challenges. The Internet TESL. Journal, III (6). Wang, F. & Burton, J. (2013). Second Life in education: A review of publications from its launch to 2011. British Journal of Educational Technology, 44(3), 357–371.

Shea, P., & Bidjerano, T. (2009). Cognitive presence and online learner engagement: a cluster analysis of the community of inquiry framework. *Journal of Computing in Higher Education*, *29*(3), 199–217.

Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers & Education, 55*(4), 1721–1731.

Swan, K., Garrison, D. R. & Richardson, J. (2009). A constructivist approach to online learning: The community of inquiry framework. In C. R. Payne (Ed.), Information technology and constructivism in higher education: Progressive learning frameworks (pp. 43–57). Hershey, PA: IGI Global.

Traphagan, T., Chiang, Y., Chang, M., Wattanawaha, B., Lee, H., Mayrath, M., Woo, J., Yoon, H., Jee, M. & Resta, P. (2010). Cognitive, social and teaching presence in a virtual world and a text chat. Computers & Education 55(2), 923–936.

Wang, X., Kim, B., Lee, J. W. Y., & Kim, M. S. (2014). Encouraging and being encouraged: Development of an epistemic community and teacher professional growth in a Singapore classroom. *Teaching and Teacher Education, 44*, 12–24.