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On the value of Second Life for students' engagement in blended and online courses: A comparative study from the Higher Education in Greece

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Abstract Nowadays three-dimensional (3D) multi-user virtual worlds (VWs) are the most well-known candidate platforms in Higher education. Despite the growing number of notable studies that have presented VWs as valuable platforms for the e-Education, there is still a paucity of a comparative study in order to be determined the degree of the students' engagement in constructionist-collaborative learning scenarios. Concurrently, it seems imperative the need for educators and scholars to identify how can VWs influence students' engagement in contemporary and reliable instructional formats, mainly on blended or online settings for university-level courses. In this study the effects of students' achievements were measured by comparing the degree of students' engagement from two student groups (graduate and undergraduate) enrolled in two different instructional formats (blended/online) held in Second Life (SL) to become learning content developers. The purpose of the current research is to present results from the comparative study of one hundred twenty-five (125) students that finally attended in order to be measured their engagement overall as a multi-dimensional construct consisting of the emotional, behavioral and cognitive factors. The study findings from the quantitative analysis have disclosed that graduate students who participated in online courses achieved more positive learning outcomes and as a result the degree of their engagement was significantly increased than those who enrolled with the blended. In these circumstances there are raised some fundamental educational implications which are also discussed.

Keywords Student engagement · e-Education · Higher education · Virtual worlds · Second Life

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1 Introduction

The increasing mediation of Information and Communication Technologies (ICT) and computer-supported collaborative learning (CSCL) transactions in different disciplines and in various educational levels have revealed some of the most important perspectives for both cultural and social cognition. Inasmuch as, the pervasive utilization of Web 2.0-based transactions or resources and the wide adoption of online social networking platforms mainly those that depicted on a computer screen with a three-dimensional (3D) environment have led to the proliferation of visually-rich learning materials in multi-user virtual worlds (VWs). As 3D technologically-advanced environments, VWs have endorsed various social dimensions mimic to those of the real world, where all users (students and instructors) have the potential to collaborate and communicate (synchronously or asynchronously) in real-time without significant distractions.

These kinds of content can hold great eventual for deriving students' attention or motivation regardless their ages or their (socio-)cognitive background with richer representations in their knowledge domain that is transferred in an innovative but yet candidate (learning) platform. This domain should not only be well-structured due to the abundance of diverse multimedia content in which a 3D VW can replicate, but it should also have the availability of various digital sources with contextual information, ranging from the location metadata and textual descriptions of online interactions to the user's (instructor and students) feedback. Therefore, leveraging social multimedia content and its surrounding context may offer ample instructional affordances or educational opportunities for better understanding users the real's world problem-based learning situations and co-constructing innovative and engaging applications.

VWs as a legitimate part of ICT are the most important and worthwhile innovations to date contributing greatly not only to improve learning outcomes, but also to provide the enhancement of pedagogy at all levels of the e-Education, in order to develop an innovative "knowledge field" that will help students to be successful to the 21st century demands (Bouta and Retalis 2013; Pellas et al. 2013; Wang and Burton 2012). These situations have led instructors and researchers to develop innovative learning educational instructional formats with a unique design that besides being adapted to replace the face-to-face (f-2-f) did not only allow the contact between students and instructors, but also contributing or even empowering the acquisition of knowledge. Online and blended learning are two of the most eligible and reliable instructional formats that have been emerging during the 21st century (Marchand and Gutierrez 2012).

The online learning method has a rudimentary structure and the selection of courses by many students always vary, depending on their cognitive background, while in the same case it can be still useful to inspire other people who want to continue their education and improve better their skills for their professional or personal advancement, but they are not in an academic sector. Indeed, this method can offer significant solutions derived from the reduction or elimination of financial benefits until the contribution of serious contemporary educational needs (Xu et al. 2013).

On the other side, the blended learning method defined from Garrison and Kanuka (2004) as the effective combination of face-to-face (f2f) teaching procedure with the online technology in a learning program. The anticipated outcomes from students'

activities can be enhanced when the visually-rich 3D virtual reality (VR) technology thoughtfully integrated into the traditional instruction (Burnett 2011).

These contemporary methods can provide various learning affords and can become more efficient to adequately engage students in using ICT transactions and rich media sources for various activities, something that is not so sufficient with the conventional (face-to-face) approaches. Students' engagement seems to become a very significant point of view in online and blended learning as these methods approve an interactive set of communication for instructors and students in the class that may facilitate collaborative activities even beyond the traditional frameworks of a classroom (Kali et al. 2009).

With the fundamental tendencies of the above contemporary methods it can may clearly for us to distinguish some other benefits that have already been confirmed from the literature and may facilitate the learning procedure (Sitzmann et al. 2006; Tayebinik and Putch 2012; Yam and Rossini 2011). These are as follows:

- The exploration of unlimited searches from the Web or Web 2.0 sources.
- The increasing availability of learning materials for students who choose not to attend in conventional face-to-face offerings into their classrooms (for economical or work reasons).
- The assembling and disseminating instructional content which is cost-efficient, enabling instructors to handle easier students' coordination in groups during the learning procedure.
- The maintaining learning outcomes which are equivalent or significantly higher compared with other face-to-face teaching methods may encourage students to participate and have more time for reflection in problem-solving learning situations.

Several studies in the online learning area by using different 2D (two-dimensional) platforms (Lu et al. 2011; Fransen et al. 2011; Janssen et al. 2011) have presented positive results from group comparisons, awareness or effectiveness in academic performances and students' attitudes. Although, there were some other researchers that were not found so sufficient these 2D technologies due to the identified reality where students could share experiences with others more easily with face-to-face interactions and not so sufficiently in online settings, due to: (a) the technical problems (Rivera et al. 2002) or feelings of isolation that were provided by other participants (Contreras-Castillo et al. 2004), (b) the lack of previous online learning experiences (Piccoli et al. 2001), (c) the wrong expectations or differences in the instructional background of the student population between course delivery modes which were primarily used (Kleinman and Entin 2002) as sources of students' satisfaction at low levels or (d) the absence of interaction between users-content or with students-instructor, while on the other hand only there are few experienced educators knowing how to equally use several communication forms or transactions that 2D technologies can replicate (Kotsilieris and Dimopoulou 2013).

In nowadays online and blended university-level courses have not yet replaced the traditional teaching methods. However, these two novel modes of learning (online and blended course delivery methods) were launched in different (candidate) learning platforms, such as Learning Management Systems (LMS) or Virtual Learning Environments (VLEs), but unfortunately there were emerged several significant limitations. A critical issue is that LMS (like Moodle or Blackboard) was only used as document repositories (Kemp and Livingstone 2006) and these environments cannot easily

support the learner's performance during the monitoring and knowledge management phases, basically when these are produced in team-based activities (Siemens 2004).

On the other hand serious games (or game-based environments) are not even so efficient for real-time collaborative scenarios. Some of the most significant characteristics to support this thought are the following:

(a) Serious games have specific goals, pre-defined rules or storylines that users must pursue in order to gain the knowledge, but in VWs users are free to use everything (modify the time or space sense, objects, primitives or artifacts) from a common virtual (pre-constructed) "eco-system" and use various communication forms to communicate or coordinate with other peers synchronously (VoIP, gestures, chat text) or asynchronously (IM),
(b) Many serious games have geospatial or physical limitations in different 3D or 2D frameworks, but VWs have a "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).
(c) Users in serious games have only a first person option to "see their character from inside" and this characteristic is not always modifiable or changeable, but on the hand users in VWs as cyber entities (avatars) can create their visual appearances as they wish anytime that they want.
(d) Avatars as users' representative embodied cyber entities (avatars) create a scene of (co-) presence in real time situations and combine various theoretical-pedagogical backgrounds of contemporary learning theories (see Constructionism, Situated Learning or Social Constructivism) in order to co-construct students various learning activities (student-centered or collaborative constructs with inquiry-based scenarios). On game-based environments this must be obviously decided and constructed at the beginning of its production and cannot easily be changed during the activity according to users' demands or needs.

Last but not least, (e) instructional formats in VWs can include real time collaborative learning activities or problem-solving activities that allow users to redefine or redesign some multi-dimensional perspectives in order to understand something better and be fully engaged in several activities. In a game-based environment there is always a limit for constructive applications or intrinsically interesting activities for students (Pellas and Kazanidis 2013a). This opportunity can become valuable for learning as users can co-manipulate or co-create learning environments whereby they are getting immersed in a context in which they also have to transfer an innovative knowledge field that gained within the VW back into their real-lives, thereby creating important meanings with the contents and ultimately connections with the concepts being taught (Coffman and Klinger 2007; Nteliopoulou and Tsinakos 2011).

Thereupon, it is still providing a gap of how can these technologies enhance not only the learner's independence and autonomy, but also encourage them to collaborate with others during the learning procedure. Many times students didn't have the instructor's appropriate support and feedback, but they not only have needs which should be provided at the same time that they interact with the environment or with others, but they have finally the responsibility of what they should be learned and how something can be learned better. A variety of institutions in recent years of economical crisis always seek to find open source, low cost solutions or freely available platforms in

which the degree of manipulation, development and adoption of users with the learning material can become meaningful and valuable.

All the aforementioned have led many scholars and educators to utilize VWs for purposeful educational practices (Burgess et al. 2010; Dziuban et al. 2004). It seemed that VWs can fill the gap created from users' presence in a natural and artificial environment to be also achieved face-to-face communication and interaction among them simultaneously. In the light of these findings Tselios, Daskalakis and Papadopoulou (2011) have stressed that the combination of face-to-face interaction with the online instruction may offer an added value in supporting learner-centered or collaborative learning procedures. This occasion is something that was previously a key element for the use of VWs consistent with previous studies (Konstantinidis et al. 2010; Pellas et al. 2013; Vosinakis and Koutsabasis 2012).

While both instructional formats have various advantages and strong indications for future-driven training programs which can help instructors or scholars with the development of the learning procedure in a common environment on the one hand or the effective acquisition of knowledge from students, on the other educators and instructors should not only be concerned about the use of the appropriate learning environment, but they additionally need to measure students' (active) engagement in these innovative circumstances. On this occasion the aim of this study was to be measured and compared the students' (undergraduate and postgraduate) engagement after completing the same project in Computer Science courses through Second Life with the blended and online instructional format.

2 Review of the literature

2.1 Valuable candidate platforms for a contemporary e-Education

Many educational institutions and organizations are still searching for novel educational methodologies, techniques or even learning environments to reinforce teaching procedures and easily engage the "Net Generation" of digital natives (students) with the learning material. The vast majority of learning processes in contemporary instructional formats (blended/online) can offer users the ability to integrate advancements, best practices and benefits of the traditional learning methods in conjunction with various Web (2.0) -based technologies and withal VWs for users (instructors and students).

Social multi-user VWs as the most prevalent platforms for implementing various collaborative activities were not constructed for educational purposes per se; but nowadays they have globally drawn considerable attention in the students' communities. In the last seven years due to their inherent technological strength for the suitability of 3D modeling and co-manipulating opportunities that offered in many real or at least pragmatic virtual learning "places" or "spaces", which are otherwise difficult to be structured from the existing social networking sources (see Facebook or Twitter) or other LMS. Apparently, there is a notable approbation that is predominantly related to the quality of students' responsiveness or social presence and awareness through online or blended instructional formats (Vaughan 2010).

Another crucial point of criticism is that the "traditional" teaching and learning modes with two-dimensional (2D) systems (blogs, wikis, and LMS) can be suggested only for

typical educational practices and as a result their technological infrastructure is only for the re-presentation of knowledge in multiple oral or even in typing-based forms, mainly asynchronously. 3D (social) VWs may offer to students significant advantages that can overcome the above "passive" approaches due to the inherent characteristics that this 3D VR technology endorsed with the words of immersion, persistence and sociability, where users co-create the learning content, construct their own meaningful structures, and communicate their peers. The expressiveness of animated 3D graphics and real-time interactive simulations can be used not only to create real places and objects, but also to ratify abstracts or complex concepts using visual metaphors. Some of the most appropriate tools which provided as useful are the verbal (VoIP and brainstorming-based text) and non-verbal communication (gestures and important messages-IM) forms facilitating in this notion the construction of experiential-based activities in virtual workshops or micro-worlds with primitives (virtual objects) or artifacts (virtual objects that formed by avatars) and generally the visual prototyping processes of real life's miniatures that can be explored more easily without reasonable cost.

In this vein the technological infrastructure of (social) VWs, like Second Life (SL) approves multiple characteristics of the 3D VR technology, synchronous or asynchronous communication channels, and completes on the user's computer screen a 3D VR networked system to support distributed (or not) users' experiences, over 18 years old. SL defined as a "persistent" and multi-user virtual environment, because participants permit to coexist as "cyber entities" (avatars), co-manipulate or metaphor 3D visual artifacts or simply communicate via multiple forms. Within this context, students' performances can be enhanced through the acquisition of diverse training, since in real life situations required the ability to apply the appropriate skills and the right knowledge in each particular case.

The most notable literature reviews (Inman et al. 2010; Pellas 2012; Wang and Burton 2012) have proved that SL can be a nascent 3D interactive-educational platform for constructionist-collaborative activities. Similarly noteworthy some indicative examples of using SL as a candidate learning platform in Higher Education are for: (a) providing innovative learning processes in "constructionist" settings (Girvan et al. 2013; Good et al. 2008); (b) examining social interactions between users with other participants in SL in order to be determined the impact of the anticipated learning outcomes (Dickey 2010; Wang and Burton 2012; Zhang et al. 2006); (c) designing or evaluating collaborative activities (Vrellis et al. 2010); (d) implementing environmental studies (Attasiriluk et al. 2009), distance learning courses (Wang et al. 2011; Pellas and Kazanidis 2013b), which can be also associated with psycho-sociological approaches (Turkay and Tirthali 2010); (e) creating an interactive learning progression through interactive game-based spaces (Fiedler and Haruvy 2009; Terzidou et al. 2012); (f) providing an alternative option for teachers' professional development (Vasileiou, and Paraskeva 2010), (g) delivering Library and Information Science education (Luo and Kemp 2008) and (h) supporting the online and blended course delivery for teaching tourism and hospitality (Singh and Lee 2008).

The inspiration for this research was originally emerged from antecedent case studies (Mallan et al. 2010; Minocha and Reeves 2010) which have revealed from some positive findings regarding the novelty of SL, as it was generally suggested in different educational fields of the e-Education. Although, it is still lacking from the international literature a comparative study in order to be enunciated the students' engagement within the two of the most reliable learning methods (blended/online) held in SL.

2.2 Factors affecting student engagement in the learning process

Vygotsky (1978) has previously noticed the students' needs and the essential collaborative activities for the teaching and learning process in order to ensure or reinforce their engagement, motivation, and ultimately learning that occurs from the social interaction with other peers. In recent years, a renewed interest among a great body of the academic literature (Appleton et al. 2008; Finn 1993) have stated into the point of the humans' mechanisms, in which specifically students have according to their emotional reactions provided or even more behaviors during the learning procedure which can show how engaging is for them an educational practice and make easier the acquisition of knowledge that is gradually emerging (scaffolding process). Without the term of "engagement" in learning, students will stop working on activities and cannot learn or achieve the learning objectives (Winn 1997).

Until today there is a framework for the term of "engagement" encapsulating the tripartite conceptualization of factors that Fredicks et al. (2004) have described with: (a) the "behavioral factor" refers to the positive conduct, and students' participation in the class; (b) the "emotional or affective factor" enrolls to the interest, positive attitudes or values about learning; and (c) the "cognitive factor" discloses to the self-regulation, learning goals, investment in learning.

2.3 Student engagement in virtual worlds

One of the most crucial factors for the success of learning activities is the student engagement (Keller 1997; Keller and Suzuki 2004). This term is in common usage from both educational practitioners and researchers who involved in online or blended sessions, and it is provided to enhance the learner's engagement that was being highlighted as a central axis of the learning effectiveness. Jarmon et al. (2009) have mentioned that key elements of the engagement in VWs are the interactivity, the connectivity, and the access to media sources. A growing body of the academic literature (Chapman et al. 1999; Northrup 2001; Gao and Zhang 2006) also claimed that higher degrees of interactivity can also lead students' engagement in higher levels and of course in better learning outcomes.

VWs are increasingly becoming valuable educational platforms for e-Education in which users (instructor and students) have the potential to be fully engaged and finally to participate in teaching or learning processes (Coffman and Klinger 2007). VWs can be also useful as learning platforms due to their inherent ability to engage students in interactive activities with the instructor and others in a virtual class. Users' interactions in a VW create a sense of community in 3D virtual-immersed classes that otherwise might not be met in face-to-face settings (Baker et al. 2009). Learning activities in a VW allow students to discover and acquire active experiences that engage and motivate them to explore new study concepts. Students also follow learning activities that may challenge them to learn by experiencing ("learn by doing") in a common place, as they have not attended in a passive enrollment, but they try to be incorporated in a constructionist learning approach under the instructor's guidance.

The student engagement in 3D VWs can be considered both by the level of engagement that achieved by the interactions that a common 3D virtual place provided and the level of engagement that is promoted from the learning activities in which he/she is being engaged (Coffman and Klinger 2007; Dickey 2005). As Trindade, Fiolhais

and Almeida (2002) have noticed that 3D virtual worlds can facilitate the formation of conceptual models during students' engagement since these environments can provide many capabilities for them to develop applications addressing on higher level skills. The same authors stressed that the term of students' engagement in a learning experience and the empowerment of their participation in a well-structured virtual place may finally meditate some positive outcomes on their skills.

Consequently, the instructors first of all must provide compelling problem-based situations that may engage students not only in the exploratory phase of the VW, but additionally into a deep inquiry and analysis of meaningful and authentic problems that they can relate to conquer the knowledge according to the lesson's objectives (Shear and Penuel 2002). In these provisions, students must meaningfully be engaged in interactive learning activities not only by communicating with others, but also with implementing worthwhile tasks collaboratively. However, a barrier of the user's engagement is the ability of how he/she interacts with other peers in the 3D graphical user interface in realistic or at least pragmatic situations. To this notion, student engagement in specific course content frameworks and the sense of community in online or blended sessions can be enhanced by amplifying complex interactions which on their turn may eliminate any boundaries or distracts about the use of VWs for learning and teaching purposes with positive results.

3 Method

3.1 The rationale of this study

The results from a plethora of studies that utilized SL for educational purposes were positive, as it was observed that can cause students' motivation, interest and satisfaction (Bulu 2012; Cobb et al. 2009; Hew and Cheung 2010; Sturgeon et al. 2009). Certainly as regards previous research efforts (Beltrán Sierra et al. 2012; Dalgarno et al. 2009; Ketelhut et al. 2010; Marttunen and Laurinen 2009) for the learning effect according to the performance of the team trainings in a multi-user VW and compared with the performances of their control groups which was trained in a real environment, there was not found any significant differences. All these results indicated that education in VWs provided a similar learning outcome like in a real environment by offering additional advantages, increasing students' interest, ensuring security, availability or even interoperability issues with other LMS (see Sloodle, i.e. the conjunction of SL with Moodle), and thence all these processes may affect students' engagement or participation.

According to the foregoing, a VW can be provided as an alternative platform for students' collaborative learning activities, since:

(a) it can be applied to the social contexts of the general philosophical constructivism (Socio-constructivism theoretical background), wherein students' groups with different cultural and social cognition try to co-construct a unique knowledge domain collaboratively with shared artifacts and meanings,
(b) it has a low cost the construction of learning materials and provide to students the availability to change spatial or time constraints, and
(c) it can be easily co-manipulated and co-configured by users and in this way it can avoided unauthorized users with bad behaviors.

More specifically, it seemed that was not implemented a sufficient number of comparative studies based on the effectiveness from the use of contemporary learning methods between virtual and real environment. Primarily theoretically-advanced perspectives have cropped the urgent need to be done comparative studies, a research issue that have also been emerging during the last five years and emphasized not only to the utilization or additional value in the educational processes of 3D multi-user VWs compared to other 2D environments (Kamel Boulos and Maramba 2009), but also to other educational issues such as the students' experiences in virtual communities (Reinhard 2012) and the learners' performances in game-based settings within VWs (Loh 2013).

Antecedent comparative studies with experiential-based data related with the Science and Technology courses in multi-user VWs. Two of these are affiliated to problem-based learning approach in primary (Hickey et al. 2009) and secondary education (Bouta and Retalis 2013; Ketelhut, et al. 2010) respectively which were based mainly on the collaborative exploration between participants, data collection and inference, rather than in the implementation of studies in computer laboratory activities. The other four experiential-based comparative studies were in Higher education presented the comparison of: (a) the instruction in a real and a virtual classroom (Beltrán Sierra et al. 2012; Chen et al. 2012), (b) the comparison of familiarizing students in a laboratory for real and virtual tour (Dalgarno et al. 2009), (c) the comparison of presenting an actual laboratory experiment with the individual conducting the virtual (Cobb et al. 2009) and last but not least (d) a comparative study of Papachristos et al. (2013) have proved that the design of the virtual place (open air or auditorium) cannot necessarily affect the users' experiences in an educational multi-user VW.

Despite that recent studies focused methodologically more on case studies and less on comparative; it is still needed to be done an empirical study to investigate the effectiveness that is usually associated with the concept of students' engagement during their participation in learning activities held in SL. In this vein, the rationale of this study was raised from all the above literature review in which it was not yet provided controversial results from any empirical study to deal with the comparison of students' engagement in collaborative (blended or online) settings. In these dimensions the effectiveness of the same project with the utilization of SL as a candidate learning platform in Higher education was deemed as necessary in order to be amplified the differences and opportunities that can be emerged during the learning procedure for graduate and undergraduate students.

3.2 The research question, the main purpose of this study and the anticipated contribution

Given the fact that many universities have deployed and offered innovative different course delivery methods with both blended and online instructional formats through SL (Pellas 2012; Wang and Burton 2012); however the respective added value or otherwise the effectiveness of these methods on students' engagement are largely unknown. An emerging research hypothesis that can be raised was if it can be any significant differences on students' engagement through the blended or online university-level courses by utilizing SL. Seemingly, this study seeks to measure the growth-promoting factors (emotional, behavioral and cognitive) that may affect student engagement in blended and online courses, which to date have not been examined yet.

The overarching research question of this study was: *how might contemporary instructional formats (blended/online) influence the students' engagement in the virtual world of Second Life?*

The purpose of this study was to be measured and compared the students' (undergraduate and graduate) engagement after completing the same project in Computer Science courses through the virtual world of SL in blended or online instructional format.

The present study seeks to fill the void that depicted from the literature review and it presents the results of the students' engagement through an empirical comparison of a collaborative activity that was implemented in Computer Science course different instructional formats (blended and online) held in SL. The expected contribution should be proceed from the results and can become an important guidance for other future-driven learning directions which can utilize SL for educational purposes in different formats concerning the following: (a) the potentially best learning outcomes which can be provided some additional instructional affordances that may assist students to participate and learn with others in a common 3D visually-rich environment (b) the highlighting issues relating to the physical (or not) users' presence in a common virtual environment, and how this learning evolution with its results (i.e. the acquisition of knowledge) can affect learning outcomes, (c) significant usability issues about the communication tools that facilitate: (i) the learning process and how innovative media resources in a 3D VW can be coped according to students demands or needs and (ii) enhance the quality of cooperation and satisfaction between users from it at a more agreeable climate which is different from traditionally defined.

3.3 Design and learning procedure

The present study started in the middle of October in 2012 with two different instructional learning approaches and finished in November of the same year. Data were gathered from students who enrolled in the spring semester courses at the Kavala Institute of Technology (KIT), in Greece. The research was based on an experience-based approach and criteria of a quantitative research method. Both blended and online courses were followed a 6-week calendar during the university winter semester, with the same instructor, for the same project and of course in the same virtual platform (SL), but with different instructional formats (blended/online) in order to be accomplished an experiment that will be used for future-driven Computer Science courses.

The content of those researching efforts was focused on constructive learning applications with SL's functional characteristics that applied users to utilize the Linden programming language (LSL) and script objects or artifacts for the construction of a 3D "micro-world" that can be furnished for the experimentation ("learn by doing") activities without real-world repercussions. The current project has the same objectives for both groups.

The research was expanded to include all those students from other three different disciplines whose mutual course was the *"Computer Science and ICT services for e-Education"* and wished to provide a study in alternative instructional formats and platforms that traditional (face-to-face) cannot easily offer, as a means to improve and facilitate the acquisition of knowledge. The course was entitled as the *"The design of collaborative virtual learning spaces* via *3D visual prototyping in Virtual Worlds."* All courses were focused on the possible use of *"Collaboration & Design in Learning"*

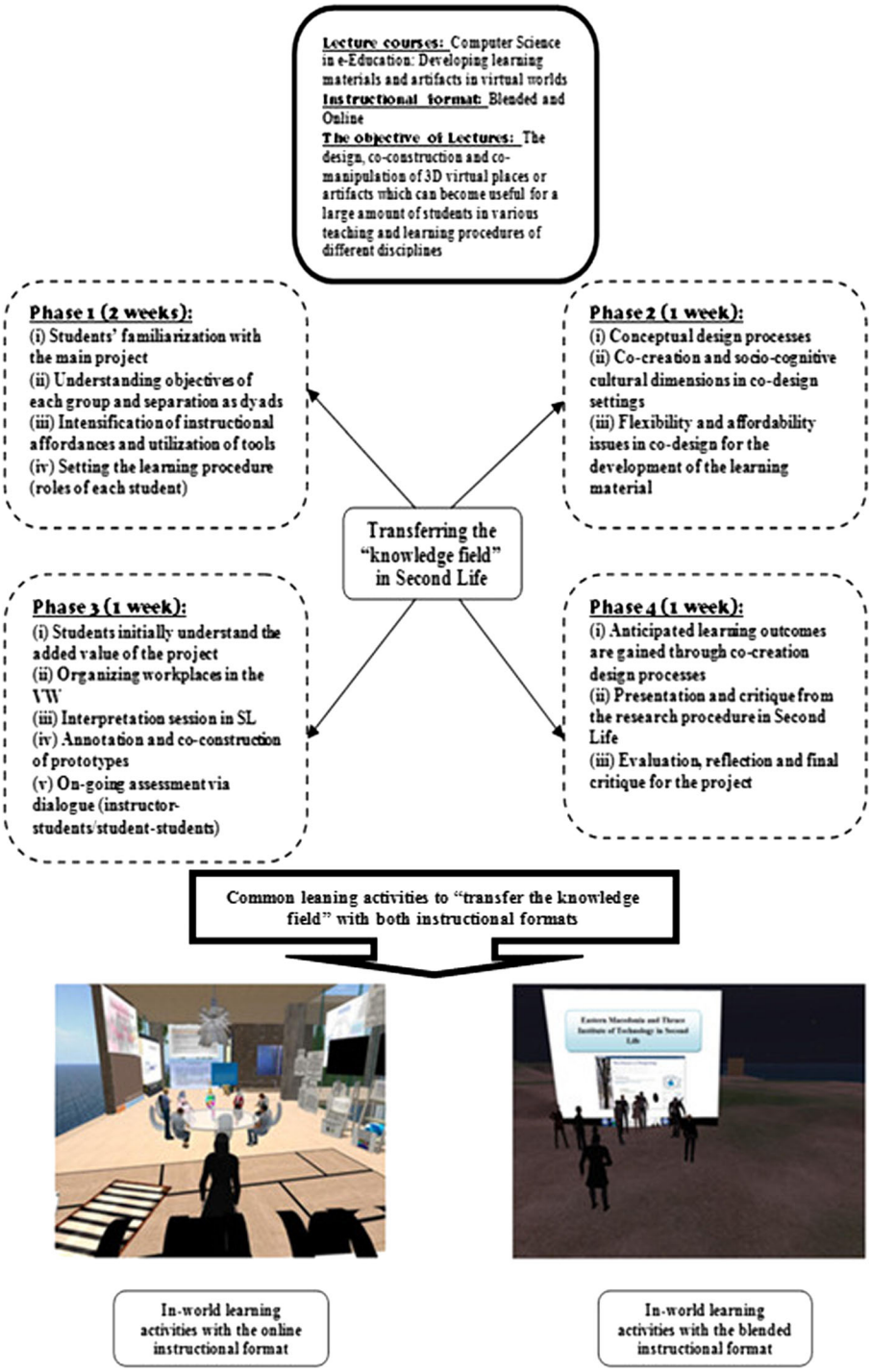

Fig. 1 The learning procedure in Second Life in blended and online university-level courses

(CDL) processes and results provided by utilizing students 3D virtual places and artifacts that can be useful for a larger group of users for various teaching and learning processes. The aim of the current treatment was to learn and amplify students some innovative "socio-constructivist" processes and affordances from the utilization of 3D VWs supported from alternative instructional methods, and of course understanding how to use these pre-constructed 3D "eco-systems" as reliable and viable platforms for e-Education.

As Herrington, Oliver and Reeves (2003) underlined the student engagement is increased when learners are able to interact and create objects within a virtual environment. Students of this project seek to become *"Learning content developers in virtual worlds"* was focused on: (a) developing, designing, advising on and evaluating tools or artifacts (e.g. by constructing PowerPoint presentations and integrate them in visual artifacts to connect them with other LMS like Moodle) that with collaborative workshops were implemented by the same students for formal or informal college-wide professional development activities, (b) facilitating the assess to expertise services or new media resources relating to technologically-advanced learning procedures, (c) taking care as "experts" to design learning content in 3D VWs with collaborative activities that can be implemented according to the related interests or objectives of each Department (as students were from different disciplines), in order to increase other colleagues awareness beyond the exiting practice and exchange ideas for other future-driven collaborative practices.

Table 1 Frequency and percentage of the socio-demographic characteristics

	N (%)	Blended Method (%)		Online Method (%)	
		Undergraduate students (%)	Graduate students (%)	Undergraduate students (%)	Graduate students (%)
A. Previous experiences with Web 2.0 applications					
1. 1–6 months	32 (23.7)	5 (8.1)	8 (44.5)	5 (31.9)	4 (50)
2. 7–12 months	47 (42.2)	25 (40.3)	10 (55.5)	20 (42.5)	2 (25)
3. More than a year	46 (34.1)	12 (51.6)	0 (0)	12 (25.5)	2 (25)
Overall	125	52	18	37	18
B. Student's status					
B.1. Part-time student	72 (60.7)	30 (48.3)	10 (55.5)	30 (85.1)	2 (25)
B.2. Full-time student	53 (39.2)	22 (41.7)	8 (44.5)	7 (41.9)	6 (75)
Overall	125	52	18	37	18
C. Fields of Study					
C.1. Social Studies	17 (12.6)	0 (0)	0 (0)	15 (88.2)	2 (11.8)
C.2. Economics	32 (23.7)	11 (34.4)	8 (25)	11 (34.4)	2 (6.2)
C.3. Civil & Architectural Engineering	13 (9.6)	1 (7.7)	0 (0)	10 (76.9)	2 (15.4)
C.4. Computer Sciences	63 (54.1)	40 (68,5)	10 (13.7)	11 (15.1)	2 (2.7)
Overall	125	52	18	37	18

N number of students

With blended training sessions students had traditionally a 2-hour weekly virtual (in-world) held in SL and class meetings (f-2-f) in a computer lab, according to students' needs and demands. During the first week particular meetings were in SL (or alternatively one week the meeting was in the computer laboratory and the following was in-world). In the initial encounters, problems that existed were about procedures that students should follow for the in-world meetings (e.g. making visual artifacts, recognizing the communication tools), and in the next class lesson was a discussion of the first results and the formative assessment of this issue.

With online training sessions students had a 2-hour weekly (at a distance) class meeting in SL (in-world) was structured. Although, the first two sessions were also implemented with the teleconference program Big Blue Button (BBB), which had been directly connected with Moodle that was previously being used for the students as a "warehouse of knowledge". In addition, students selected the appropriate link into the Moodle online course and they were automatically connected to the teleconference virtual room. The first online session was an easy and student-friendly process. In the first session the original concepts were discussed and the instructor presented SL and how the students could interact with it. The other sessions took place through SL. After this process, students try how to configure their avatars and how to use SL tools via a client viewer (Fig. 1).

3.4 Measures

The construction of the main instrument was adapted from Kong et al. (2003) study, translated in the Greek language while it was kept the anonymity of each participant.

Table 2 Students' engagement reliability indices

Engagement factors	N	Cronbach's alpha of students' answers in online courses	Cronbach's alpha of students' answers in blended courses
Emotional engagement	22	0.793	0.791
Interest	6	0.802	0.792
Achievement orientation	6	0.788	0.777
Anxiety	5	0.769	0.796
Frustration	5	0.814	0.802
Behavioral engagement	14	0.831	0.799
Attentiveness	6	0.854	0.789
Diligence	6	0.847	0.811
Time spent	2	0.789	0.799
Cognitive engagement	21	0.818	0.802
Surface strategy	7	0.788	0.789
Deep strategy	7	0.811	0.801
Reliance	7	0.855	0.817

*Cronbach's alpha requires a reliability of 0.70 or higher to obtain on a sustainable sample

N number of items

Table 3 Engagement factors of the independent sample t-tests in blended courses

Engagement factors in blended courses	Research group	N	Mean	SD	t	Sig.
Overall	Undergraduate	52	4.13	0.36	−1.53	0.43*
	Graduate	18	4.23	0.33		
EE	Undergraduate	52	4.35	0.22	0.56	0.95
	Graduate	18	3.81	0.29		
BE	Undergraduate	52	4.24	0.44	−2.35	0.26
	graduate	18	4.22	0.42		
CE	Undergraduate	52	3.88	0.54	-0.75	0.42
	Graduate	18	3.54	0.51		

*$p<0.05$

EE emotional or affective engagement; *BE* behavioral engagement; *CE* cognitive engagement; *N* number of items; *M* Mean; *SD* Standard Deviation

Questions were emanated from: (i) the cognitive engagement with 21-item questions (surface strategy, deep strategy, and reliance), (ii) the emotional engagement with 14-item questions (interest, achievement orientation, students' anxiety and frustration), and (iii) the behavioral engagement with 22-item questions (attentiveness, diligence and time spent to complete a project). The above instrument's validity compromised from: i) statistical methods, and ii) the students' engagement, which for this questionnaire was mainly configured for Higher Education courses as it was the most prevalent in this study.

After completing various activities that depicted in Fig. 1, 125 voluntary correspondents answered a 57-item self-report questionnaire, according to a 5-point Likert scale (1=disagree to 5=strongly agree). Each part took no more than 25-minutes to be completed and it was sent to students by email.

Table 4 Engagement factors of the independent sample t-tests in online courses

Engagement factors in online courses	Research group	N	Mean	SD	t	Sig.
Overall	undergraduate	37	4.63	0.26	5.47	0.02*
	graduate	18	3.58	0.71		
EE	undergraduate	37	4.77	0.19	5.44	0.03
	graduate	18	3.54	0.85		
BE	undergraduate	37	4.54	0.21	4.59	0.01
	graduate	18	3.58	0.78		
CE	undergraduate	37	4.57	0.29	5.14	0.03
	graduate	18	3.61	0.67		

*$p<0.05$

EE emotional or affective engagement; *BE* behavioral engagement; *CE* cognitive engagement; *N* number of items; *M* mean; *SD* standard deviation

Table 5 Paired sample t-tests scores between blended and online groups of graduate and postgraduate students

Engagement factors	Research group	N	Mean difference	SD	t	Sig.
Overall	undergraduate	89	−0.76	0.78	−3.47	0.02*
	graduate	36	0.52	0.35	6.75	0.04
EE	undergraduate	89	−0.84	0.86	−3.64	0.03
	graduate	36	0.41	0.27	5.94	0.04
BE	undergraduate	89	−0.67	0.75	−3.59	0.01
	graduate	36	0.74	0.45	6.37	0.02
CE	undergraduate	89	−0.63	0.98	−2.54	0.03
	graduate	36	0.44	0.43	4.25	0.01

*$p<0.05$

EE emotional or affective engagement; *BE* behavioral engagement; *CE* cognitive engagement; *N* number of items; *M* mean; *SD* standard deviation

4 Results

4.1 Sample

The sample composed of 125 (adult) trainees (40 female and 85 male) from the KIT, with 70 (56 %) participants to be enrolled in blended and 55 (44 %) in fully online university-level sections (see Table 1).

The first intention was to describe the socio-demographic results from trainees' e-profiles, as Table 1 summarizes. Among to 125 members, all of them enrolled in blended or online courses and agreed to complete an anonymous (online) questionnaire. All students never before have been taken part in either blended or online groups, but they had at least a month of experience with Web 2.0 sources or transactions (like Wikipedia, Facebook or Twitter).

Table 6 Independent sample t-tests scores between blended and online groups mean scores

Engagement factors	Research group	N	Mean Difference	SD	t	Sig.
Overall	Blended	70	0.36	0.24	−2.47	0.02*
	Online	55	0.71	0.35		
EE	Blended	70	0.31	0.28	−1.64	0.13
	Online	55	0.53	0.29		
BE	Blended	70	0.49	0.31	−2.59	0.19
	Online	55	0.74	0.42		
CE	Blended	70	0.33	0.31	−1.54	0.43
	Online	55	0.57	0.47		

*$p<0.05$

EE emotional or affective engagement; *BE* behavioral engagement; *CE* cognitive engagement; *N* number of items; *M* Mean; *SD* standard deviation

4.2 Data analysis

According to the analysis of the main research question, the three engagement factors used as dependent variables, whereas each phase of measurement (i.e. online and blended instructional formats) were also measured. The two groups were used as independent variables.

Table 2 shows that the online group reliability analysis of Cronbach's alpha has an equally satisfying internal consistency for the overall student engagement (a=0.814). Additionally, in the students' group enrolled in blended settings the overall reliability testing Cronbach alpha was 0.797, which was also highly satisfying (see recommendations from Singh 2007).

Both undergraduate and graduate groups in blended method considered an equivalent concerning at the level of the overall engagement, even before their intervention to the SL. Independent samples t-tests at the level of significance (p<0.05) were not indicated any statistically significant difference [t(50)=−1.53, p>0.05] in Table 3.

As Table 4 shows for online courses the effect on the overall and each engagement factor between graduate and postgraduate groups after the online intervention which was desperate. Independent samples of the *t*-test betoken a statistically significant difference in favor of the first group [t(35)=5.47, p<0.05], [t(35)=5.44, p<0.05], [t(35)=4.59,p<0.05], [t(35)=5.14, p<0.05].

Table 5 depicts a paired sample *t-test* between the undergraduate and graduate scores for determining the intervention effect on the learning engagement of both groups, which disclosed a statistically significant difference in favor of the graduate mean scores [t(87)=−3,47, p<0.05]. On the other side, concerning the postgraduate group mean scores were significantly higher for those of the graduate level [t (34)=6.75, p<0.05].

Also, as Table 6 affirms the comparison of the mean scores between blended and online methods of two subgroups, as it was found that there is a statistically significant difference in favor of the blended group [t(68)=−2.47, p<0.05].

5 Discussion and conclusion

The student engagement is a generally accepted term by many scholars and researchers as the centerpiece of the learning effectiveness (Dickey 2005; Trindade et al. 2002; Zhang et al. 2006). However, this term in VWs should be further combined with a broader context through students' immersion and motivation in order to essentially participate individuals with other peers in any collaborative learning activity. Consequently, the student engagement remains a crucial factor for the success of many activities in modern learning environments, and it is also particularly important for many case studies that utilized VWs (Dale and Lane 2007; Reeves and Read 2009). Therefore, it is necessary to be considered the level of engagement that firstly is achievable from: (a) the interactions between users, and (b) the learning material provided within educational activities.

The degree of success in which each learning space in a VW engages students must depend on the student's motivation in multiple activities that can be implemented in a common virtual place (Mount et al. 2009). Subsequently, since the students' adoption in 3D VWs is becoming more valuable for students in a common virtual place, it may

be emerged the urgent need of what students can precisely learn from their involvement in 3D technologically-advanced environments. This distinction very clearly indicates that unique constructs and issues which posed to the student engagement may guide instructors to determine the suitability and usability of VWs in particular learning tasks.

The study results have unveiled students' satisfaction and engagement in higher levels for the online course delivery methods, despite that the sample constituted from different educational disciplines and cognitive backgrounds. More specifically, the quantitative analysis intimated that graduate students of online courses had significant positive results by utilizing the SL, rather than those who participated with the blended method. The study results also revealed that the overall engagement level of the graduate students who had been enrolled with the online instruction had significantly higher levels of engagement in various learning tasks than the undergraduates who enrolled with the blended. However, after the intervention in the case of the second group, the degree of engagement diminished significantly whereas, conversely in the case of the online group the level of engagement was increased. Furthermore, the graduate subgroup that enrolled with the online method reported significantly higher points of an overall engagement compared with the blended. In other words, graduate students may have previous experiences in online courses and this may help them to be reconciled with this method.

In this vein students' engagement can be fostered in VWs when they participate in interactive learning processes and discussions with other peers (Ang and Wang 2006; Seddon et al. 2008). Hu and Kuht (2002) have reported that the most promising learning approach is this that can encourage students' engagement and can change their perceptions or anticipated learning aspects for a learning environment. Consistent to Mansour, Bennett, and Rude-Parkins (2009) the results from our study indicated that the utilization of SL may have a positive impact on experiencing a high perception of students' social interaction in online courses. Undoubtedly, previous studies (Drossis et al. 2013; Kim and Gracanin 2012; Lapin 2010) have created the necessary presuppositions for the investigation of students' engagement in 3D multi-user VWs with a more extensive sample. Gregory and Lloyd (2010) have focused on the use of VWs in order to promote the students' active participation in authentic (or at least pragmatic) learning activities to achieve common learning outcomes.

According to our comparative study, the online method seemed to be a reliable instructional format for students. Noteworthy it can be mentioned that while the success of SL as a candidate learning platform in enabling an engaging environment is generally widespread accepted (Deutschmann and Panichi 2013; Hornik and Thornburg 2010), it is important to be provided the instructor's feedback in real-time during participatory activities or students' involvement in the learning process.

In fact to identify the main reasons of the divergence between the two student groups who enrolled in different situations to increase their degree of engagement in ICT courses, it was also observed some other problems attended with groups enrolled in the blended method encountered in f2f interaction, during the class (computer laboratory) session. These problems are mainly focused on: (a) forming students in dyads groups, (b) managing the learning material, (c) following face-to-face or in-world instructions during learning and teaching processes, in order to synchronize or present students' projects, as the instructor was given quickly the appropriate feedback at the same time,

and (d) implementing quietly an activity, as their peers' questions expressed loudly in the laboratory or via brainstorming-based progressions from the online group in SL.

In terms of the educational-practical implications, it was clearly understandable that SL: a) can engage and in parallel serve the students' needs and mainly of those who attended in online sessions, or those who leave far away from their university, b) can reduce running costs and contribute to savings of revenue, c) can provide a better understanding of the added value of VWs for constructive-collaborative activities and 3D visual prototyping processes. Another positive point of view was that SL cannot be any more the "Pandora's Box" for the e-Education, but must be easily connected with the educators and students' needs, encapsulating innovative instructional formats. Notwithstanding that SL provides a plethora of new possibilities and affordances, it also presents a host of new challenges that truly need further exploration.

6 Limitations of the study

Some crucial limitations which we should be worth bearing in mind when interpreting the present findings were:

(a) the sample size was voluntary; indeed 125 correspondents wanted to participate from the overall 175 (response rate 71.5 %);
(b) the students' characteristics (socio-cognitive background, novice, moderate or expert level in the use of ICT and Web 2.0 services) may differ from students of other universities;
(c) the results of this study cannot be generalized beyond the education program at the specific university.

7 Future work

The future research needs to elucidate and amplify the relationships of the engagement factors with:

(a) usable authoring tools for instructors to better monitoring the learning process, and
(b) best design collaborative practices for rethinking the innovative approach in order to reinforce instructors' continuing professional development.

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