Implementing collaborative e-learning functionality in Second Life

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Key words: 3D Educational Virtual Environments, Collaboration, Constructivistic Learning, Second Life, Educational Scenarios

Abstract:

This paper initially discusses the potential of Second Life for supporting collaborative learning by evaluating its functionality against some basic design principles. Furthermore, the paper presents the features that we have implemented within the Second Life platform, in order to facilitate collaborative e-learning scenarios.

1 Introduction

Collaborative virtual environments (CVEs) have many advantages compared to tools supporting traditional teaching methods. Education programs designers should have these advantages in mind, when designing courses, in order to meet students' needs as well as the education objectives. The advantages may vary from student motivation and entertainment to the simplification of the development of cognitive models from complicated or abstract material. Moreover, researchers have proved that collaborative learning activities generally lead to better learning and socialization results for the students, and even better when the students' learning styles vary considerably [1].

Depending on the instructional methods employed, CVEs can support constructivistic learning, in terms of distributed and situated learning [2]. A virtual learning environment can distribute knowledge and cognition among the various artifacts (such as tools and virtual objects), the students themselves (for example when they collaborate to solve a problem, or to perform an experiment) [3], and symbols, as it introduces new chances for scientific thinking and new ways of presence through the avatar existence in the virtual space. In other words, students learn while they associate with more or less experienced participants of the learning community [4], and virtual environments can boost such sociocultural practices.

Today there are many 3D multi-user collaborative environments, offering tools and services that can be categorized with regard to their functionality into communication tools, teacher and student support tools, tools for coordinating the collaborative learning process, shared applications and photorealistic humanoids [5]. The platforms that tend to integrate these features seamlessly seem to be more useful for educational uses.

The purpose of this paper is to compare the existing CVE platforms, examine whether Second Life can be used for educational purposes and present the tools we have implemented in order to facilitate the learning process.

First of all, we introduce some essential elements of a learning environment based on a virtual world and we present the comparison of the most popular CVE platforms based on these elements. Secondly, we attempt to evaluate the Second Life platform, using a set of principles proposed in [6]. Such a set of principles can help educational designers to design and customers to choose a CVE platform for educational use. Finally, we present the way virtual environments can be used to apply real-life e-learning scenarios based on instruction methods.
used in traditional education, as well as the tools we implemented within Second Life to help the application of these scenarios. Some of the most popular platforms, that have been used or proposed for education are Project Wonderland (https://wonderland.dev.java.net/), Croquet (http://www.opencroquet.org/), Worlds (http://www.worlds.net/), Tixeo (www.tixeo.com/), I-maginer (www.i-maginer.fr), Active Worlds (http://www.activeworlds.com/), There (http://www.there.com/), Dive (http://www.sics.se/dive/), Moove (http://www.moove.com/), Second Life (http://secondlife.com/). For a platform to be used in education, there are several elementary functionalities that have to be offered. These functionalities were used to review the previous platforms and can be grouped in a few generic categories:

- Space and collaborators awareness / avatars (the virtual representative of the user), which determines the level of the user’s immersion in the environment based on the realism of the user’s representation and the ability to change it, their orientation within the environment, the interface usability and the awareness of their collaborators.
- User groups and access control, which determines whether groups can be created within the community, if different roles can be assigned to users of the same group and if the access to objects or communication can be controlled.
- Concurrent, collaborative creation and manipulation of shared resources, which determines the level of collaboration that can be achieved, based on the users’ ability to create shared objects within the virtual environment, to share applications and to extract the results.
- Communication means and media, which indicate the means that can be used to enhance the educational process, such as chat or audio / video-conference.
- Other, mainly technical and financial specifications

The functionalities described above is a useful set of requirements to check against, when choosing a virtual learning platform.

The review of the platforms is summed up in Table 1, Table 2, Table 3 and Table 4. More specifically:

- Table 1 compares the CVE platforms in terms of functionality for supporting space and collaborators awareness and avatars
- Table 2 compares the CVE platforms in terms of functionality for supporting access control and user groups
- Table 3 compares the CVE platforms in terms of functionality for supporting sharing and manipulating resources
- Table 4 compares the CVE platforms in terms of functionality for supporting user communication

Please note that in the following tables “N/A” means that either there was no information about the specific feature or the platform was not available at all.

<table>
<thead>
<tr>
<th></th>
<th>Realistic Avatar</th>
<th>User Interface&amp; Installation Usability</th>
<th>Immersion Quality</th>
<th>Avatar Customization</th>
<th>Maps - Orientation</th>
<th>Collaborators Awareness</th>
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<tbody>
<tr>
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<td>slightly</td>
<td>moderate</td>
<td>good</td>
<td>hard</td>
<td>No</td>
<td>moderate</td>
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<tr>
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<td>easy</td>
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<td>good</td>
</tr>
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<td>moderate</td>
<td>moderate</td>
<td>easy but limited</td>
<td>No</td>
<td>good</td>
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<tr>
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<td>much</td>
<td>good</td>
<td>good</td>
<td>N/A</td>
<td>N/A</td>
<td>very good</td>
</tr>
<tr>
<td>I-maginer</td>
<td>enough</td>
<td>good</td>
<td>good</td>
<td>N/A</td>
<td>N/A</td>
<td>very good</td>
</tr>
<tr>
<td>Active Worlds</td>
<td>enough</td>
<td>good</td>
<td>very good</td>
<td>easy but</td>
<td>supports</td>
<td>very good</td>
</tr>
<tr>
<td></td>
<td>Realistic Avatar</td>
<td>User Interface &amp; Installation Usability</td>
<td>Immersion Quality</td>
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<tr>
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<td>good</td>
<td>easy</td>
<td>supports</td>
<td>very good</td>
</tr>
<tr>
<td>Second Life</td>
<td>very much</td>
<td>good</td>
<td>very good</td>
<td>very easy</td>
<td>supports various</td>
<td>almost excellent</td>
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Table 1: Space and collaborators awareness / avatars

<table>
<thead>
<tr>
<th></th>
<th>Custom User groups</th>
<th>Roles assignment</th>
<th>Floor control</th>
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<tr>
<td>Croquet</td>
<td>indirectly</td>
<td>indirectly</td>
<td>indirectly</td>
</tr>
<tr>
<td>Wonderland</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Worlds</td>
<td>N/A</td>
<td>N/A</td>
<td>elementary</td>
</tr>
<tr>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>I-maginer</td>
<td>yes</td>
<td>N/A</td>
<td>elementary</td>
</tr>
<tr>
<td>Active Worlds</td>
<td>yes</td>
<td>yes</td>
<td>elementary</td>
</tr>
<tr>
<td>There</td>
<td>yes</td>
<td>N/A</td>
<td>elementary</td>
</tr>
<tr>
<td>Dive</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Moove</td>
<td>N/A</td>
<td>N/A</td>
<td>elementary</td>
</tr>
<tr>
<td>Second Life</td>
<td>yes</td>
<td>yes</td>
<td>elementary</td>
</tr>
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</table>

Table 2: Access Control and user groups

<table>
<thead>
<tr>
<th></th>
<th>Manipulation of space and objects</th>
<th>Concurrent objects manipulation</th>
<th>Results exporting</th>
<th>Instructional tools availability</th>
</tr>
</thead>
<tbody>
<tr>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>moderate</td>
</tr>
<tr>
<td>Wonderland</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>minimum</td>
</tr>
<tr>
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<td>N/A</td>
<td>N/A</td>
<td>no</td>
</tr>
<tr>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>I-maginer</td>
<td>yes</td>
<td>yes</td>
<td>N/A</td>
<td>yes</td>
</tr>
<tr>
<td>Active Worlds</td>
<td>yes</td>
<td>yes</td>
<td>N/A</td>
<td>great (AWEDU)</td>
</tr>
<tr>
<td>There</td>
<td>yes</td>
<td>no</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Dive</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Moove</td>
<td>yes</td>
<td>N/A</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Second Life</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>great</td>
</tr>
</tbody>
</table>

Table 3: Sharing and manipulating resources

<table>
<thead>
<tr>
<th></th>
<th>Chat</th>
<th>Audio - Conference</th>
<th>Video - Conference</th>
<th>Streaming Audio</th>
<th>Streaming Video</th>
<th>Gestures</th>
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<tbody>
<tr>
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<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Wonderland</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
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</tbody>
</table>
Among the other counterpart platforms, Second Life (secondlife.com) seems to be one of the most promising ones, concerning online education, because of the fact that it implements most of the functionalities, often in a more efficient and usable way compared to the other environments, the generality of its features and the already significant acceptance by the community. By July 2008 there were at least 1 million active users among 14 millions of registered users and countless islands (i.e. a piece of land in Second Life) dedicated to education purposes.

What makes Second Life more acceptable for education organizations is the fact that it is already ported to the dominant personal computer platforms and many open source Second Life compatible alternatives are being developed besides.

Although Second Life has a rich enough feature set, that does not make it directly convenient or ideal for educational use.

Since the early uses of virtual environments in learning, researchers have tried to establish a schema that incorporates some well known aspects, issues, elements and principles, and should be taken into account during the design process of virtual worlds targeting on learning.

### 2 Evaluating the framework for a flexible e-classroom in Second Life

Since the early uses of virtual environments in learning, researchers have tried to establish a schema that incorporates some well known aspects, issues, elements and principles, and should be taken into account during the design process of virtual worlds targeting on learning. The rationale behind the designers’ decisions can have a significant effect on the appropriateness of the platform for education. Regarding the design adequacy of Second Life for online learning purposes, we validated the platform's features, philosophy and policies against the design principles presented in [6]. These principle are the following:

- Principle 1 - Design to support multiple collaborative learning scenarios
- Principle 2 - Design to maximize the flexibility within a virtual space
- Principle 3 - Augmenting user’s representation and awareness

<table>
<thead>
<tr>
<th></th>
<th>Chat</th>
<th>Audio - Conference</th>
<th>Video - Conference</th>
<th>Streaming Audio</th>
<th>Streaming Video</th>
<th>Gestures</th>
</tr>
</thead>
<tbody>
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<td>Worlds</td>
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<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Tixeo</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>N/A</td>
<td>N/A</td>
<td>yes</td>
</tr>
<tr>
<td>I-maginer</td>
<td>public, private</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Active Worlds</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>There</td>
<td>public, private</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Dive</td>
<td>public</td>
<td>yes</td>
<td>no</td>
<td>N/A</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Moove</td>
<td>public, private</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Second Life</td>
<td>public, private, conference</td>
<td>public, private, conference</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes, fully customizable</td>
</tr>
</tbody>
</table>
• Principle 4 - Design to reduce the amount of extraneous load of the users
• Principle 5 - Design a media-learning centric virtual space
• Principle 6 - Ergonomic design of a virtual place accessible by a large audience
• Principle 7 - Design an inclusive, open and user-centered virtual place
• Principle 8 - Design a place for many people with different roles

Next we are presenting our rationale for validating the platform's features, philosophy and policies against the above design principles.

• **Principle 1** - Design to support multiple collaborative learning scenarios: A useful tool for collaboration would support the execution of many e-learning scenarios. The e-learning scenarios can combine one or more instructional methods like role-playing, case studies, team projects, brainstorming and many more, as long as the environment supports their functional requirements. There are many collaborative learning scenarios that can be supported in Second Life, some of which are explained below. As the virtual world supports text chat (private and public), voice chat, streaming video and audio, interaction with objects and the forming of groups, there is a wide variety of tools that can be used directly or developed. However the lack of desktop applications sharing support is a definite drawback.

• **Principle 2** - Design to maximize the flexibility within a virtual space: Space parameters like size, architecture, facilities and the physical environment affect the way learners socialize [7]. Virtual environments, to be eligible for generic educational use, must fulfill the teacher's expectations for flexibility of time and space. Thus, due to the need for multiple functionalities within a collaborative online synchronous session, it should be possible to quickly reorganize the virtual place for a particular activity or scenario. In Second Life there are unlimited capabilities regarding the space's organization. The teacher, using custom scripts, can allocate the space instantly, satisfying the learners' needs. In an even simpler manner, the teacher can move any object around and split the classroom into domains, suitable for team-work.

• **Principle 3** - Augmenting user’s representation and awareness: Combining gestures, mimics, user representation, audio and text chat communication as well as application sharing provides to the users the ability to share their views and to show the object that they are talking about, while other users are also aware of who and for what they talk about. Second Life’s avatars are very flexible in customizing so that they not only look quite realistic, but also permit to each user to display their own unique style, therefore enhancing user representation. The realistic walking and sitting animations, customizable gestures, typing animations and sounds, as well as the head and eyes which move to show what the user is looking at, increase awareness of other users that are around and what they are doing.

• **Principle 4** - Design to reduce the amount of extraneous load of the users: The main objective of an e-learning environment is to support the learning process. Therefore, the users should be able to understand the operation of the learning environment and easily participate in the learning process. The major commands of interfaces should be available in a graphical user interface fashion. Second Life is designed in a way that prevents a user's extraneous load. The built-in browser, the flexible preferences menu that allows the user to select the graphics quality and performance and the obvious distinction between shared and non-shared objects not only prevent extraneous load, but also make it possible for users with average and maybe somewhat outdated computers to be able to use the environment efficiently.

• **Principle 5** - Design a media-learning centric virtual space: The virtual space should be enhanced by multiple communication and media layers. Each media type (e.g., text,
graphics, sound, etc.) has advantages (Schneider, 1996). The virtual space should integrate many communication channels (such as gestures, voice chat, text chat, etc.) in order to enhance the awareness and the communication among the users. Second Life is by design a media-centric platform. Users can communicate by many means; text, voice; even avatar live-video-mapping is possible. In addition, users can upload textures, or stream audio and video into the world. Lately, a web browser has been embedded in the graphical user interface. Support for viewing and manipulating more kinds of documents may be added as long as the platform can handle application sharing.

- **Principle 6** - Ergonomic design of a virtual place accessible by a large audience: The designers of a virtual place should take into account that a virtual place for e-learning could be used by various individuals with different backgrounds and level of expertise in information and communication technologies. Second Life is indeed accessible by a large audience and the in-world tutorials, that guide the user during his/her first actions, make it pretty easy for everyone to enter and learn quickly how to use the environment.

- **Principle 7** - Design an inclusive, open and user-centered virtual place: Second Life Membership is free, anyone above 18 years old can join (there is also a separate world for teenagers) and the virtual content of the world is created by its users. A significant drawback is the fact that organizations must pay monthly fees to the owners of the platform to be able to own and administer land parcels in the virtual world. While this may be reasonable, as the company takes care of the maintenance and the expansion of the virtual world, some organizations would rather invest these resources in customizing the world for their own needs. Although this is impossible right now, many open – source Second Life – compliant alternatives are developed at this time and will be available shortly.

- **Principle 8** - Design a place for many people with different roles: An e-learning system should support a variety of roles with different access rights. For example, in a collaborative learning scenario the participants could be moderators, tutors, or learners. The virtual space should be designed accordingly for differentiating these roles. One very important in-world function included in Second Life is the creation of groups. This function permits the group creator (owner) to assign different roles to group members and to set the according rights to each role. The creation of a group makes it possible to differentiate the users, which in education would mean giving different rights and roles to administrators, teachers, students and guests.

### 3 Using the virtual space to apply instructional methods in real-life e-learning scenarios

It is quite easy to notice that what is missing today from e-learning methods does not concern the theoretical foundation, but the teaching and learning practice. This fact is pointed out by the lack of experimentation and the creation of projects where learners have a chance to apply what they have been taught.

It is essential that the implementation of educational scenarios in the virtual world of Second Life not only covers both the theoretical and practical fields, but also exploits all the available in-world functionalities to emphasize on the second. What in real life would seem unlikely, like giving authorization to an architecture student to build a house or mall, or for a biology student to actually enter a human cell, in Second Life it would be a very effective way to learn and experiment by-doing. Furthermore, the multiuser substance of second Life can support collaboration among the students.

Although virtual worlds are commonly related to simulation - based learning and consequently individual learning, they can greatly enhance collaborative learning through simulation. In a simple scenario, students can build their own simulation from the ground up,
creating the 3D objects and breathing new life into them by constructing the simulation model. This way they participate in a constructivistic, collaborative learning activity that is proved to be very effective.

While contemplating the implementation and effectiveness of an e-learning scenario, it is important to answer the following questions in a precise manner:

- What is the purpose of the scenario, which the virtual environment has to support?
- Where will the learning process take place?
- Which are the necessary tools that make the learning process of the scenario more effective?
- What is the role of each participant and what are the important details of this scenario's learning process? How will the tools mentioned before be used to enhance education?

The scenarios we are implementing in order to support collaborative e-learning by exploiting Second Life’s capabilities are the following:

- Instruction
- Problem solving in class
- Collaborative Research Projects
- Collaborative discovery / case study projects
- Collaborative model creation projects (shared objects)
- Role-playing
- Structured virtual lab experiments session
- Immersive simulation

The following paragraphs present the above scenarios by describing their purpose, the place that the learning process is substantiated, the necessary tools and the roles of each participant.

### 3.1 Instruction

**Purpose:** Online lecture for the teaching of a subject's theoretical aspects  
**Place:** A traditional classroom or amphitheater is needed for the learning process. This scenario supports a great number of students.  
**Tools:** An image projector or a widescreen in case of streaming video use, a virtual microphone.  
**Roles and actions:** The teacher has the primary role, as he talks about the subject and there is not much time for questions, exercises or problem solving. The teacher can use either the projector or the widescreen for his presentation and can use either text chat or voice chat. In the case of text chat he will need a virtual microphone so what he says is carried over to the students sitting further away. In the case of voice chat, the students will have to focus their camera on the teacher and zoom in on him, and set their Preferences so they can hear voice chat from their camera position. The students can keep notes of the lecture in note cards or log the chat by checking the appropriate box in Preferences. They can also take snapshots of the presentation and save them to their hard disk, store them in the library for further reference or Finally, the teacher can hand out the presentation slides, through a group notice, in the form of a virtual book attached locally onto the student’s screen (Head-Up Display – HUD).

### 3.2 Problem-solving in class

**Purpose:** Solve problems and exercises, get the students’ questions answered and generally practice what they have learned so far as to better understand the newly acquired knowledge.  
**Place:** A traditional classroom with a capacity of about twenty people would be ideal for this case.  
**Tools:** The necessary tools include a virtual chalkboard or/and an interactive whiteboard.  
**Roles and actions:** The teacher is the students’ guide, as they try to solve exercises. In case the chalkboard is used, a student can solve the exercise for everyone to see and then the teacher
gives out the solution in note cards. In case the whiteboard is used, the students can take a snapshot and save it to disk.

### 3.3 Collaborative research projects

**Purpose:** Create research projects through collaboration in order for the students to understand what they have learned so far, get more information about the subject and write a paper about it.

**Place:** A room for every group of 2-4 people (or up to 8 in case of a project between students studying different subjects)

**Tools:** The group will need a round table to discuss their project, a library to get information from, a step board that shows the steps that have to be completed, a brainstorming log so their conversation and ideas are saved and a progress indicator so the teacher can know at any given moment if the students have finished, are working or need help.

**Roles and actions:** The students collaborate with each other and the teacher is there only to help them in case they encounter any problems. Having read the questions of their project, they use the information from the library, discuss the subject, use the brainstorming logger to record their thoughts on it and then write their conclusion in a note card and hand it to the teacher.

### 3.4 Collaborative discovery / case study projects

**Purpose:** Research on a practical subject and application of the newly acquired knowledge in order for them to understand it and learn how to use it.

**Place:** A room for every group of 2-4 people (or up to 8 in case of a project between students studying different subjects)

**Tools:** Most of the tools are similar to those of the previous scenario. The group will need a round table to discuss their project, several interactive objects to experiment with, a library to get information from, a step board that shows the steps that have to be completed, a brainstorming log so their conversation and ideas are saved and a progress indicator so the teacher can know at any given moment if the students have finished, are working or need help.

**Roles and actions:** The students collaborate with each other. The role of the teacher is only to help them in case they encounter any problems. They get information from various objects and according to the case they are studying, they have to choose the best solution. When they finish they can find out if their answer was correct through an object. As an example, studying the symptoms of a sick animal and trying to diagnose the illness, the students have to decide what medication to prescribe by looking up the symptoms, diseases, medicines and quantity according to the animal.

### 3.5 Collaborative model creation projects (Shared objects)

**Purpose:** Collaborative creation of a 3D model relevant to the taught subject.

**Place:** Depending on the size of the model that will be created, the students can collaborate in a room like the previous scenarios or even outdoors.

**Tools:** The tools mentioned above can be used here too to figure out what the model will look like and how it will be constructed by consulting references from the library. The main tool needed though, is the in-world building tool that allows the students to create and share objects.

**Roles and actions:** The teacher is guiding the students during their first creations to help them learn how to use the building tool and then s/he only interferes when a group needs her/his help.
3.6 **Role-playing**

*Purpose:* Understanding situations, application of knowledge and appropriate behaviors in a realistic environment.

*Place:* Depending on the subject it can be anywhere, in a shop, in a museum, on the stage of a theater etc.

*Tools:* Tools vary depending on the subject; their main purpose is to add to the experience so that it seems more realistic.

*Roles and actions:* The teacher assigns a role to every student and indicates the situation they will be role-playing. The students then apply their knowledge in the best way possible, in order to accomplish their goal. As an example, an ideal role-play for Law School would be a mock trial, where students play the parts of the judge, lawyers, jury etc.

3.7 **Structured virtual lab experiments session**

*Purpose:* The acquisition of knowledge through experimentation and the application of already known information.

*Place:* A laboratory with a capacity of 20 people.

*Tools:* Several different interactive objects that simulate experiments so the students can be divided into groups and each group can observe a different experiment at the same time. Objects that store the experiments' results and the students' notes are also necessary.

*Roles and actions:* The teacher shows the students how to use the artifacts and then leaves them to experiment and write down their results. As soon as they have finished, the teacher explains the details of each experiment and what the results really mean.

3.8 **Immersive simulation**

*Purpose:* Understanding situations, concepts and behaviors through discovery learning

*Place:* The simulation can take place anywhere, depending on the subject, but it usually takes place inside a 3D model of the subject (e.g. a virtual cell or molecule)

*Tools:* Interactive objects within the model that either give information or perform an action demonstrating one of the model's functions.

*Roles and actions:* The teacher gives the students introductory information about the subject the simulation is about and then the students enter the model. They click on objects and observe what happens, taking notes if needed. This scenario can be complemented by a "treasure hunt", during which every object gives the students clues that lead them to other objects. This way the students discover in a game-like environment the information they need to learn.

4 **Implementation**

The following figures (Figure 1 to 4) are presenting some of the implemented scenarios.
Due to its wide user audience, Second Life doesn't actually contain enough ready-to-use tools to support teaching and learning. For example a whiteboard must be developed by the users using the LSL scripting language. Having in mind the scenarios discussed before, we designed and implemented some demonstrative tools for a virtual classroom or a collaboration space. These tools are equivalent to the real world ones, but in the virtual world context they may gain some additional value, primarily because of the virtual world's inherent lack of time and space limitations. Let us present briefly the tools and structures we developed, accompanied with the respective screen shots:

- **Whiteboard**: Second Life doesn't offer any kind of drawing surface. Most classrooms need one, because the participants usually visualize their thoughts on it. The developed whiteboard supports some primitive shapes like lines and circles and plenty colors. In front of the actual drawing plane, we have installed a transparent matrix board that permits the users to display predefined textures including letters and signs. All textures and shapes can be extended at will. Except its drawing capabilities, the whiteboard offers access and synchronization services, as it can be switched to 3 modes of collaboration (teacher, individual student, everyone). Students can ask for their turn using the built-in floor control. These features are accessible through the personal Head – Up Display that every participant wears.

- **Bookcase**: This is a simple but fully equipped bookcase. Every book contained in it can be a collection of Second Life supported assets (like textures, text, landmarks, etc) or a hyperlink to an external, web resource. The bookcase features a search mechanism. The user can enter a keyword and the matching books pop up to indicate the match.
Manipulating the books collections is as simple as possible, and access control is available as well.

- **Announcement Board**: The announcement board offer immediate briefing for an institution's latest news. Every announcement comes with the date it was published, floating above it.

- **Process Steps Board**: This is a simple tool to support collaborative learning activities. A teacher inserts and arranges the steps of a structured team activity into the board. Afterwards, the students start the activity and update the board to indicate the step they are working on, whether they have finished the other steps or need help. This way the teacher can be aware of the teams' progress with less effort.

- **Collaboration Table**: This table can dynamically generate the chairs needed around it, so that a team can easily have a place to discuss.

- **Progress display**: The learners can use this tool to indicate whether they are working, have finished or facing a problem in a way similar to the process steps board. What's more, the teacher is notified by the tool whenever the learners call for help. The progress display can be attached to the door of a special collaboration room.

- **Brainstorming Logger**: Though Second Life logs every chat activity in the respective window, learners may want to log their brainstorming session separately. Using this tool, the students can chat in a separate chat channel, and display the conversation floating over the tool. Later, the text can be dumped into the public chat window.

Following there are some representative screen shots of the tools we developed:

![Whiteboard](image1)
![Bookcase](image2)
![Announcement Board](image3)
![Progress Display](image4)

5 Conclusions

Given the usefulness of 3D virtual environments for supporting learning communities, Second Life can be a convenient choice as an online virtual platform. It is proved to satisfy to a high
degree, some common design requirements, and thus provides the functionality needed to support a variety of teaching methods and scenarios. Second Life stands out among similar virtual environments mainly because it is easy to install and use, and it is customizable enough to support the creation of learning environments and experiences. The given functions cover the most important needs for communication, collaboration, awareness and administration, and in the same time enable the designers to benefit from them using the built-in scripting language. The demonstrative tools we developed can be useful in a summative evaluation of the platform, either for generic or for specific educational use.

In the current assessment, Second Life was evaluated only against some predefined principles and a collection of possible learning scenarios. Further research should validate the effectiveness of the various instructional methods used in real world classrooms, when they are applied in a virtual environment. This issue is expressed strongly by educators that already have developed learning environments, which tend to be used rather individually than collaboratively.

While Second Life is already used in education practice, there are some obstacles in the way to its broader acceptance. People that use computers for educational purposes often need to transfer data, media or any kind of information between applications. As there cannot be any platform to recognize each and every file format, most virtual platforms that are concerned about interoperability, implement a 2D application host into the world; Second Life is not capable of that at the moment. Concerning the Second Life interoperability, an important step is the latest initiative by IBM and Linden Labs to standardize some aspects of the virtual world. An interoperable virtual world enables avatar teleporting to other, maybe totally open, virtual worlds. Taking into account the fact that organizations currently must pay monthly fees to own a land parcel, it is a matter of time for alternative, custom, open and interoperable with Second Life solutions, to gain ground.

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