Advantages and Drawbacks of Sloodle application for creating high-quality teaching materials with demanding graphics

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Abstract— **Due to is potentials, Sloodle virtual environment has been used to create medical course for training medical staff in the field of orthopedic. As opposed to conventional practice, where 3D models of vertebrae and spine are difficult to obtain and expensive for the preparation, Sloodle medical course allows participants access to high quality 3D models in virtual world at any time. The paper presents main features of course design and implementation. Besides, the internal evaluation is performed aiming to analyze the possibilities offered by presented environment in order to determine whether tutors can use Sloodle to obtain high-quality teaching materials with a reasonable investment of time and knowledge. The evaluation included six categories of questions and assessed the Sloodle tools management, upgrading, collaboration, costs and simplicity of adding 3D models, ease of programming, etc. The advantages and drawbacks are discussed in detail.**

I. INTRODUCTION

Over the last few years, there has been growing interest in the medical and public health communities for using virtual learning environments (VLE) for education and training [1]. Unlike traditional learning and practice on real patients, virtual environment allows students to learn by making mistakes. Students can also be on remote locations, and still have the opportunity to attend the training. Along with that, the Serbian national project "Applying biomedical engineering in pre-clinical and clinical practice" strives to create the VLE course for training the medical staff in the field of orthopedics, particularly spine column deformities.

Apart from appropriate educational content, the course needs to satisfy different aspects of the training, such as high quality 3D models of different spine column deformities, availability, cost effectiveness, etc. While Learning Management Systems, such as Moodle [2] perform most of these functions, they still limit students to deal with only specified activities and to have virtually no control over the conditions in which activities occur. Such missing functions of the LMSs have been overcome through the contribution of the tools that exist in 3D virtual environments, such as Second Life (SL) [3], which provides a new range of educational opportunities [4]. Both LMSs and SL have necessary functions for learning not exists in the other. Integration of these two systems is presented in the form of Simulation Linked Object Oriented Learning Environment (Sloodle) [5]. Due to its capabilities, we have chosen Sloodle for our course design and implementation.

Sloodle environment provides a variety of different tools, which make managing educational activities in Second Life easier [4]. Some of the tools are used in the medical course for delivering lectures or collecting feedback and assignments related to Second Life activities.

There is large number of research regarding application of VLE in medical education [6], [7], but just a few of them relates to Sloodle [8], [9]. The same environment is applied for trainings in different fields, such as programming languages [9], or Computing Graphics [10]. We didn't find any published research regarding Sloodle application in the field of orthopedics. The overview of course preparation and its Sloodle implementation is described in detail by authors in [11].

II. COURSE DESIGN AND IMPLEMENTATION

The "Spine – functions and deformities" medical course is implemented on Moodle platform within Faculty of technical sciences Cacak, University of Kragujevac. The virtual Island College of Scripting, Music, and Science, Horsa [12] is selected to be the starting point in Sloodle VLE. Renting or purchasing a land for the permanent course maintenance is planned in the near future. Sloodle module called Sloodle Controller is used to connect Moodle course with Second Life.

We have designed medical course based on principles of instructional design, and according to consultation with medical expert (Fig. 1).

Due to assumption that medical staffs are not familiar with virtual worlds, first topic of the course offers basic guidelines for existence in Second Life, such as creating avatars (a virtual representation of themselves), acquiring appropriate skills, connecting users' avatar to their Moodle account, etc.
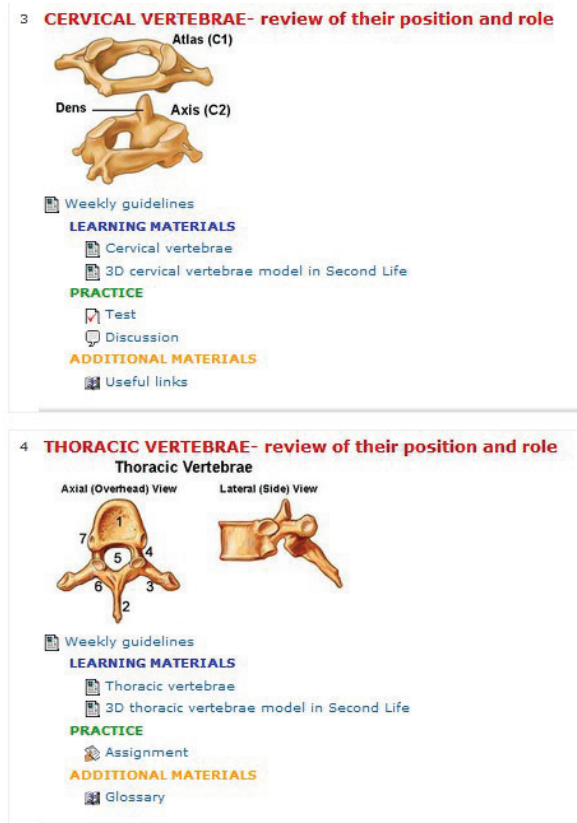
Figure 1. The screenshot of Sloodle medical course "Spine – functions and deformities"

After accommodation to virtual environment, users will recall their knowledge of detailed structure of the spinal column, and through series of activities focuses on different spinal deformities with special emphasis on scoliosis, kyphosis and lordosis.

A detailed list of course topics is the following:

- Second Life – introducing to virtual world
- Spine column – basic concepts
- Cervical vertebrae – review of their position and role
- Thoracic vertebrae – review of their position and role
- Lumbar vertebrae – review of their position and role
- Sacrum and Coccyx – review of their position and role
- Scoliosis – diagnosis, types, treatment
- Kyphosis – diagnosis, types, treatment
- Lordosis – diagnosis, types, treatment
- Comprehensive self evaluation

Topics are organized in three sections: learning materials, practice and additional materials. Learning materials are rich in multimedia resources. Apart from that, learning materials include links to Second Life locations where 3D models of particular vertebrae are placed (Fig. 2).

Figure 2. Overview of the fifth lumbar vertebrae in Second Life

Because of its complex structure, reflected in the large number of surfaces, graphic spatial models cannot be directly created or imported to Second Life. They are externally developed in CATIA software, which is the most powerful and widely used CAD (computer aided design) software of its kind in the world. Upon the successful creation of spine parts models, we have experienced the serious problem while trying to upload them in SL. The uploading led to huge number of triangles and vertices in Second Life that cannot be linked again into one model. After the extensive research, we resolved this issue by introducing Blender application. When the model is inserted in program, through series of steps its number of triangles and vertices were reduced (without losing the model quality). The process of uploading edited vertebrae model to Second Life is same as any other object (Fig. 3).
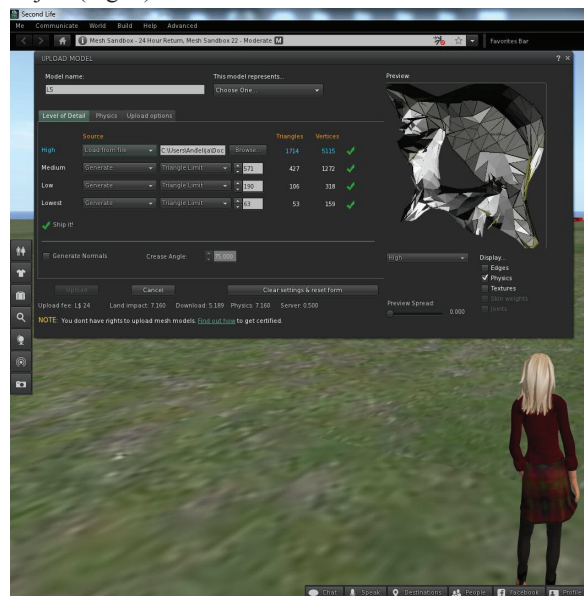

Figure 3. Uploading vertebrae model from Blender to Second Life

In order to additionally enhance models' visualization we have used Linden Scripting Language (LSL), which is official Second Life programming language. The LSL functions are used to add functionalities to spine part models, such as appropriate actions and labels. Fig. 4 shows part of the LSL script used on vertebrae model.

The course practice section contains tests and assignments that can help users to test their knowledge. Additional course materials contain useful links, terms and other assistance to the appropriate topic.

```
default
{
    touch_start(integer x)
    {
        integer side=llDetectedTouchFace(0);
        if(side==0)
        {
            llSetColor(<1,0,0>,0);
            llSetLinkColor(LINK_SET,<1.0,0.0,0.0>,0);
            llSetText("You have touched red surface",<1,0,0>,1.0);
            llTargetOmega(<1,0,0>,PI/4,0.5);

        }

        else if(side==2)
        {
            llSetColor(<0.0,1.0,0.0>,2);
            llSetLinkColor(LINK_SET,<0.0,1.0,0.0>,2);
            llSetText("You have touched yellow surface",<0.0,1.0,0.0>,1.0);
            llTargetOmega(<0,0,1>,PI/4,0.5);

        }
        else if(side==3)
        {
            llSetColor(<0.0,0.0,1.0>,3);
            llSetLinkColor(LINK_SET,<0.0,0.0,1.0>,3);
            llSetText("You have touched blue surface",<0.0,0.0,1.0>,1.0);
            llTargetOmega(<0,0,-1>,PI/4,0.5);
        }
    }
}
}
```

Figure 4.   Overview of LSL script

Two categories of Sloodle tools were used during the course design. Enrolment tools manage student access permission for a virtual classroom, help students register at Moodle and enroll them in the appropriate Moodle course.

Educational tools allow students to work with Moodle activities in Second Life. Within each topic we used the following Sloode educational tools:

▪ WebIntercom. It connects chat sessions in Second Life to Moodle chatroom. Given that this is synchronous activity, we anticipated its usage for chat sessions where user will have discussion on particular issue, such as different treatment of lordosis, etc.
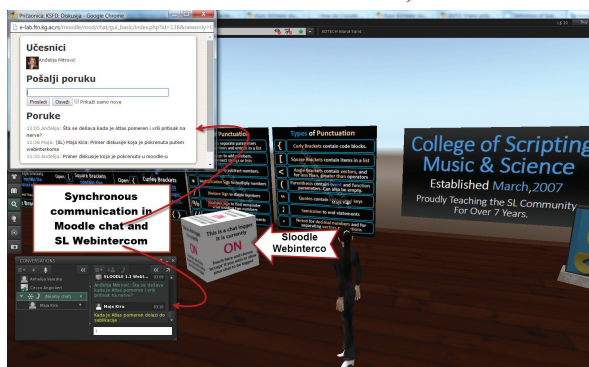

Figure 5.   Application of Webintercom tool

▪ MetaGloss is also one of useful Sloodle tools, which allow access to Moodle glossary.   Each topic has glossary, which contains terms used in that topic. For example Thoracic vertebrae – review of their position and role topic contains glossary that contains terms such as Vertebral Body, Spinous Process, Transvers Facet, etc.
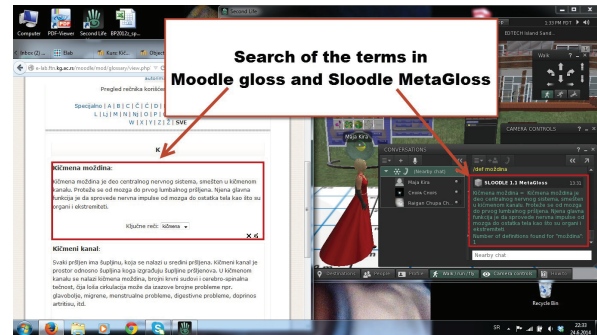

Figure 6.   Application of MetaGloss tool

▪ Quiz is Sloodle tool used for testing. Quiz can be accessed from Moodle as standard test, or from Second Life as Quiz Chair. Primary purpose of quizzes in our medical course is self-evaluation. For example, after processing a topic related to kyphosis, users can do the quiz, which deals with various types of kyphosis and thus test their knowledge. Results from quiz performed in Second Life can be later reviewed in Moodle.
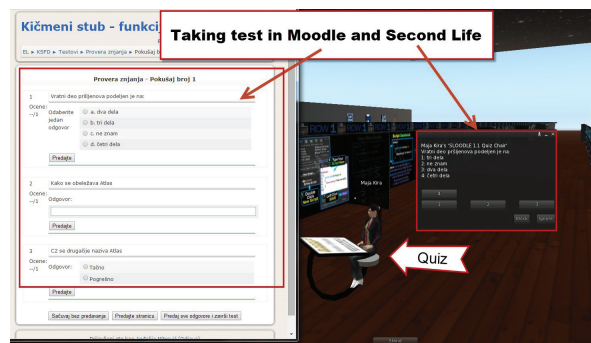

Figure 7.   Example of quiz in Moodle and Second Life

▪ Prim Drop tool allows users to submit Second Life objects in a Moodle database. Tutor can create assignment, which requires users to choose appropriate spine model among several available models. Users will submit chosen model using Prim Drop tool. This Sloodle tool will additionally engage users to hand in assignments in-world.

It should be noted that it is planned to use some more Sloodle tools, which require ownership or renting the land, as envisaged in the near future. Such tool is Sloodle Presenter, which enable participants to view presentations and videos related to the spinal cord, in Second Life, which are previously posted on Moodle.

Before presenting the course to the users, we have conducted internal evaluation with questions about Sloodle tools management, possibilities for upgrading, collaboration, costs and simplicity of adding 3D models, ease of programming, etc. The main aim of evaluation was to determine whether teachers can use Sloodle to obtain useful and high-quality teaching materials with a reasonable investment of time and knowledge.

III. EVALUATION OF VIRTUAL ENVIRONMENT COURSE

This section provides internal evaluation of proposed virtual learning environment. The goal of evaluation is the subjective analysis of possibilities offered by presented environment. The response is given from tutors' aspect. The questions are classified in six categories:

- Access to the course and Account
- Structure of course and resources
- Communication tools
- Progress Tracking Tools
- Technical Issues
- Collaboration issues

Table 1 shows the list of evaluation questions and responses that are developed by course designers and technical assistants. The Likert scale is used for responses, ranging from (5 – high satisfaction) to (1 – low satisfaction).

According to the provided response, it can be concluded that, in general, presented environment provide many useful opportunities and enhancements for teaching process.

IV. ADVANTAGES AND POTENTIAL DRAWBACKS FROM TEACHER'S PERSPECTIVE

There are several advantages for choosing Sloodle application to create medical course. Participants can enhance their skills and knowledge through work with different 3D models of vertebrae and spinal cord, which are often not available in real life practice. Also, traditional practice requires participants to be at the same time in the same places, which is time and space consuming task. In the Sloodle environment participants can be at remote locations and still attend training with their own pace.

In addition apparent advantages for participants, some features that are important from tutor's aspect have to be explained in more detail. First, connecting Moodle to Second Life through Sloodle is straightforward, and user documentation is well presented. Tutor himself can do it without additional help.

By using Sloodle tools WebIntercom and MetaGloos, tutor can significantly improve communication and collaboration among the participants. Prim Drop tool allows users' avatars to submit assignments in Second Life to the Moodle site. This tool provides the tutor with opportunity to enhance creativity of assignments.

Basics of Linden Scripting Language can be learned in a relatively short period of time. Having some previous programming knowledge could be useful, but not mandatory. Primary purpose of College *of Scripting, Music, and Science, Horsa Island* is to teach how to write LSL scripts. By applying the scripts, our 3D models can rotate, move, and change its color and shape.

From the researchers own experiences, there are two main drawbacks to consider when using Sloodle. Although basic features of virtual world are free to explore, and medical course can be temporarily placed on above mentioned island, having land for permanent course maintenance and importing graphical models are chargeable.

TABLE I.
EVALUATION OF VLE COURSE

Question	Satisfaction
Access course and account	
The virtual environment allows linking orders with other platforms (Gmail, Facebook ...).	3
The virtual environment allows you to edit the user profile and enter additional information about yourself.	5
The virtual environment allows the user to view other users' accounts and insight into their current presence.	4
Structure of course and resources	
The environment allows the user to reorganize the section and change their schedules.	5
The environment allows tutor to turn on/off additional blocks (plug-in) that (do not) want to see in a course.	4
The environment allows the adaptation of the complete structure of the course according to tutor's needs.	5
Communication tools	
The virtual environment has tools for communication among participants.	5
If the system uses any form of synchronous communications, how useful are these components?	5
If conferencing software is integrated with the system in order to support group discussions and group working, how satisfactory is it?	4
Progress Tracking Tools	
How well does the tool allow tracking personal progress?	5
How rich a picture of an individual participant's interests and aspirations does the tool provide?	3
Technical Issues	
How easy is it to set up profile?	4
How easy is it to learn to use the system?	3
How time-consuming is it to enter data in profile?	4
How easy is creating graphical models?	2
How easy is working with LSL scripts?	4
Collaboration issues	
Does the tool provide shared workspaces? If so please rate the quality	4
How well does the VLE provide development of individual learning plans?	4
How easy is it for participant to collaborate in constructing a problem within the virtual environment?	4
How well does the system support collaborative working of a number of participants on the same project?	5
Does the system support submission of assignments from participant to tutor? If so please rate the quality	5
Does the system support recording and return of assessments to participants? How well does this facility meet tutors needs?	5

Second and more important drawback lies in complexity of vertebrae models. They cannot be easily created in Second Life. For their creation it must be used some CAD/CAM program, such as CATIA. And even if tutor knew how to use it, because of models complexity,

he would probably still need help of an expert in this field. Importing 3D models to Second Life can also be potential problem, but this issue is resolved by introducing program Blender. Nevertheless, this process can be time consuming.

V. CONCLUSION

Information learned in theory towards practical experience on real patients can be quite troublesome for patients as well as for students.

Although the majority of course development features are free, some still require payments, such as renting the land in Second Life, or creation of vertebrae models. Also, working with objects with demanding graphics requires additional skills that can be learned in reasonable period of time. Sloodle itself provides opportunities for upgrading, and self-developers can contribute.

Future work will be oriented towards overcoming of perceived drawbacks. Course introduction to medical staff users is also planned with further course detailed user evaluation.

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