VEGA - Virtual Environment for Geometry Acquaintance

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Abstract: Based on the functionalities available in OpenSim, a virtual laboratory was developed in which students can interact with graphic representations and evaluate their features, improving their knowledge of geometry. Among the available authoring tools, a highlight is SketchUp, used for the design and modeling of laboratory components, with the support of the Firestorm viewer, which establishes the importance of meshes within OpenSim. With the implementation of the proposed environment an effort is made to reach a level of interaction that allows students to join the virtual world in an effective and autonomous manner, in order to manage their learning process within an interactive space. The article will describe the experience of constructing the objects and integrating them in the virtual immersion environment, touching on the strategies adopted to facilitate and simplify this process with the view of involving both teachers and students as authors.

Introduction

Although geometry is seen as a more intuitive subject when compared to the other abstractions that involve the study of mathematics, situations still occur in which teaching is restricted to a set of unconnected forms, which are presented in the ideal mode for the application of formulas to be memorized and not necessarily understood by the students.

Aimed at encouraging the development of concepts in reference to geometry (analytics, plain and spatial) this research sought support of a virtual immersion environment, able to function as a space in the support of learning. The purpose is to introduce geometry into the daily context with the support of a virtual laboratory in which students can manipulate integrated geometric shapes, while at the same time interacting within the environment, stimulating collaborative learning.

The project initially included studies of certain environments in which we could implement the intended development. A solution was selected involving the integration of a set of educational objects created externally and added to the immersion environment, Open Simulator (OpenSim or simply OS). The use of solutions based on open codes was a premise of the project and the environment selected supports the different functionalities, such as: programming in a number of languages, interactive communication, graphic modeling of objects and the import of image and audio files that allow varied immersion strategies to be employed.

Learning laboratories in immersive environments

Among the studies that provided support to the research, [2] sustained the evaluation of the efficiency of immersive environments for the promotion of the students' active participation in their learning process. Research by [6] shows that activities like communication, the recognition of human movement and the use of gestures, which are a result of intrinsic human motivation, become primary activities and do not require cognitive effort to be processed in the working memory. Furthermore, it was noted that primary activities aid the processing of information that arise from secondary activities, which are explored in an educational context and require external motivation in order to generate student involvement.

The human being uses communication as a means to garner and spread information. Communication works as a base for involvement in collaborative activities, through which individuals join the forces of their working memory and become able to solve problems of greater complexity, making these spaces suitable to collaborative situations, able to effectuate new learning [6].

Another primary activity that [6] affirm bolsters new learning is imitation. The authors confirm that, when watching another person conducting tasks, the individual becomes able to copy the steps taken, reorganizing them in plans to be stored in the long-range memory. In virtual worlds, the individual can observe the realization of tasks carried out by other avatars and thus learn through them. Furthermore, access may be gained to demonstrations created through animations provided in the environment.

Programming Languages and Modeling Tools for OpenSim

According to [4], in recent years a number of virtual worlds based on immersive environments for the internet have appeared. Among these environments is OpenSim – the focus of this research –, which is an open code tool first employed in mid 2007 with the purpose of implementing a 3D environment compatible with Second Life, a proprietary license immersive software. The leading objective of OpenSim is to create a flexible and modular 3D server compatible with the viewer/client *Second Life* as well as support for multiple clients, permitting simultaneous access to the same world, via multiple protocols.

With these attributes, OS is able to load a set of functionalities developed for SL and, furthermore, support different content and programming languages. One of the languages to which OpenSim offers support is the actual language used in SL (Linden Script Language – LSL). This has a syntax similar to language C [5], and can be applied in the creation of three dimensional objects that, in turn, are cable of allocating new codes in LSL, in addition to being used to incorporate behavior to the objects in the environment. These codes can be executed in a concurrent form by the OpenSim server, with all the environment participants able to view them. OS also operates with a script language called OSSL (OpenSim Scripting Language), an LSL extension developed specifically for OpenSim, which seeks to provide a set of functionalities which, up to then, were not supported by native LSL, such as, for example, the osTeleport Agent() function, which can take an avatar from one point to another in the virtual world and, osSetDynamicTextureURL(), which allows an external dynamically generated image to be exhibited in the actual metaverse. Other languages supported by OpenSim are C#, Java and Visual Basic. Besides all the development tools, OS includes a set of functionalities such as: different communication methods among participants (audio, chat), the construction of graphic objects and the provision of multimedia resources. Figure 01 shows a section of content from the OpenSim.ini configuration file, part of the OS package, in which languages can be defined for use in the environment. The LSL standard language and the list of compilers that can be enabled are highlighted.

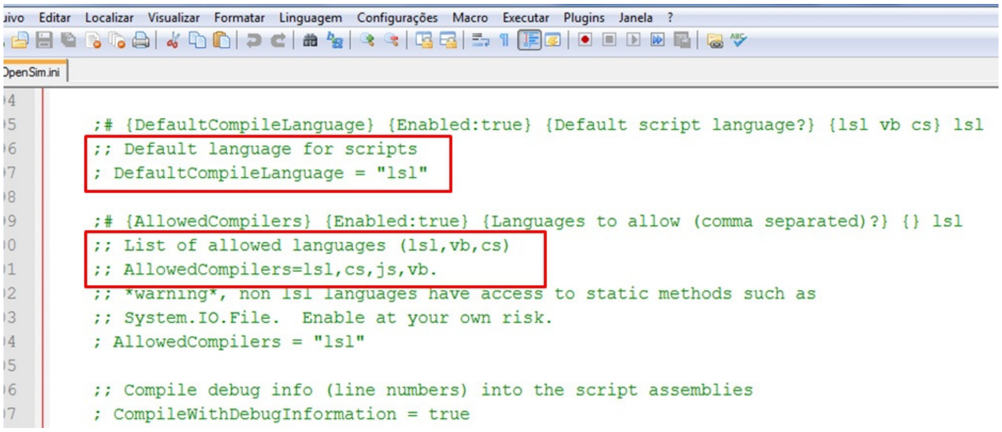

Figure 01 – Compliers supported by OpenSim

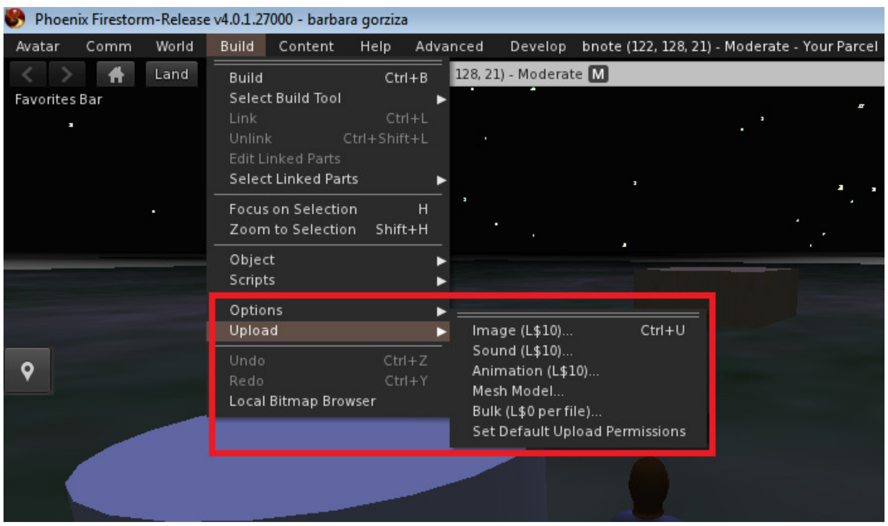

Figure 02 – Firestorm Viewer with selected object import option.

OpenSim is a multiverse that permits the importation of different external objects, implemented in different applications such as AutoCad, Google SketchUp, Blender, which provide 3D structures that can be rendered and exported to the .xml format or even taken to the immersive environment through its native extensions. These are actions that still present a certain level of complexity, due to OS being an open project and one in constant construction.

A range of applications constructed with authoring tools can also be used in these virtual worlds. As an example, objects developed in flash are in a test phase, in which .swf files are loaded in the environment by means of the web page. Another important application in a phase of testing is GeoGebra, a software that permits the union of algebra and geometry in order to permit students' experimentation in the formulation of property conjectures and testing. The integration process for these different objects is directly related to viewers or clients used in OS. This conclusion was reached following test with viewers like: Hippo and Impudence viewer, open code tools for access to virtual worlds. However, during the tests these applications presented a set of restrictions in the importation and configuration of objects. However, in simulations using RealXtend and Firestorm viewer, the object importation process can be realized in a simplified manner, as shown in Figure 02 above. The selection in red highlights the group of objects that can be imported to the environment.

Project Strategies

Initially, based on the reference on geometry, activities were employed necessary to teaching and learning the proposed theme, focusing on modular construction encompassing basic subjects through to challenging activities, thereby aiming to stimulate students' spatial notions. In this context, the levels of interactivity directly influence the development process of the student [1]. Through this, the highest level of interactivity available was sought, which can be reached through the use of immersive environments, represented in this study by the choice of the tool OpenSim.

In this research, we elaborated an educational context, aimed at teaching geometry based on three different stages: in the first stage, with the intent of understanding the concepts related to geometry, the basic themes about the area are developed: volume, coordinates and applied formulas; in the second phase, aimed at consolidating the knowledge experienced in the previous step, a repository of geometrical shapes must be implemented and provided, which will be made available to the students. The students must manipulate these objects, during this period, taking measurements and creating new geometrical objects with the existing forms; the third cycle involves the practical application of the expertise built up in the previous stages. The aim of this phase is to sharpen the students' reasoning and spatial vision, based on the concepts studied previously.

Implementation and Discussions

For the implementation of the proposed model, we structured a Virtual World, with the use of OpenSim, geared towards the development of geometry teaching. We initially drafted a guide, based on the educational structure defined beforehand and which should be constituted with the architecture presented in Figure 03.

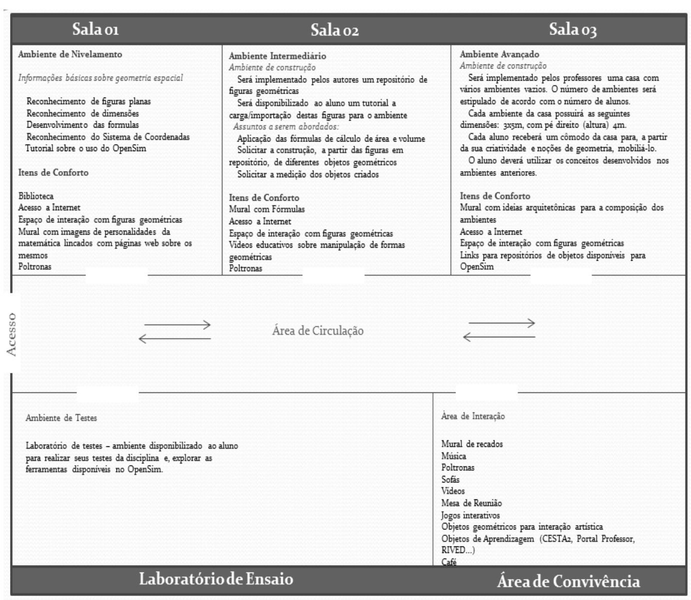

Figure 03 – Structure proposed for the VEGA environment

The guide described in Figure 03 is composed from the following interaction spaces:

Room 01, where the primary concepts of geometry are approached. It is a space for leveling expertise, concerning the theme, in which the interactive objects are made available, like links to web sites, tutorials on geometry and educational videos.

Room 02, students will have access to a repository of geometrical figures and a tutorial about the load/importation of figures to the environment. The intent is to provide means for students to experiment with their previous knowledge about geometry based on activities developed with a focus on student/object of study interaction.

Room 03 is a space for the construction, establishing a practical relationship between the studied concepts and the objects of the real world. Each student will be attributed an area in the test laboratory, with the intent of providing a space for their experiments.

The Test Laboratory will be comprised of an open area, with rooms for all the students. Within this space, students must have full control of the environment, with authorization for editing, constructing and importing new objects. Students will also be provided with a coexistence space in which they will be able to interact with the other participants. The following resources will be offered in this area: a wall with architectonic ideas for the composition of environments, access to the Internet, interaction spaces with geometrical figures and links to the object repository available to OpenSim.

In each of its rooms, the metaverse to be provided must include comfort items and permit the load of educational objects created in different authoring tools like: Autocad, Blender, Sketch-up, Geogebra and html, providing students with complementary resources, always geared towards activities developed within that space. There will also be a circulation area for access to the environments. At this point, it is important to reiterate that students can move around autonomously through the rooms, in accord with their needs and level of understanding. They are permitted to come and go whenever they feel it convenient, that is, there is no hierarchy or linear sequence for realizing the activities.

The construction of the project, in relation to the guide provided to the students, is in accord with the learning method based on experimentation proposed by [3]: Concrete experience is found in Room 01, with the contextualization of the theme. The reflexive observation, in Room 02, with the possibility of constructing new objects based on geometrical figures. Regarding conceptualization, Room 03 and the Test Laboratory, focus on the practical activity in order to encourage the students. Lastly, active experimentation is also perceived in Room 03 and the Test Laboratory, as the stages of active experimentation are reached in these environments.

Conclusion

The focus of this article was the study, test and implementation of a teaching project, in an open source immersive environment, aimed at learning in the field of geometry. Literature regarding the areas of interest was reviewed for the viability of this proposal, such as themes linked to geometry, notions and concepts on interactivity and the leading applications in virtual worlds, authoring tools and theories about learning based on new technologies.

The proposal is aimed at awakening students' interest in learning geometry applied to the real world, at the time that these students make use of a tool able to construct replicas, introducing elements that are increasingly more realistic, similar to the innumerous games that they are accustomed to.

We reiterate that, in the context of the project, the study and construction was grounded on the principals of good practices in online education, culminating in the proposal of an educational guide to a virtual world, which, according to [3] caters to the stages necessary in a learning cycle.

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