3D Simulation Environment: Education and Training

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Abstract: The advances in the interaction and visual simulation environments related to the declining cost of computers and the constant increase in the processing power, have enabled significant progress in how to interact in these environments, allowing their greater use in the analysis of real situations and as a tool for acquiring knowledge and supporting decision making. This article aims to analyze 3D simulation environments for educational purposes and to highlight the usefulness for people with special needs. The technology, combined with appropriate interactivity and visual environments, including 3D simulation can be an asset in the teaching-learning process. This paper addresses the issue by exposing case studies and features results on the behavior of students in the experience with 3D simulation environments.

Keywords: Interactivity, Simulation, 3D environment, Education, Training

1 Introduction

The technology follows the life of people showing a clear presence in their daily lives and it is also getting increasingly affordable. The adjustments as well as the technological progress are constant making new ideas, which result of the creativity and the imagination that follow the modern times, be possible.

The use of simulated environment provides interactivity and experimentation, an enabler of knowledge and analysis of various situations. Thus, among the various areas, the use of these environments in the learning process can provide greater motivation, helping the resources used in the traditional method of teaching. The models which tend to use new technologies seek simple visual environments and easily understandable by the target audience.

The 3D visual simulation is an ever-growing area, proving to be an instrument of support in various areas. Therefore, the aim of this report is to analyze, propose a prototype and explore the impact of 3D simulation environments at school in particular for people with special needs.

The main goal is to provide an idea of the tasks required to perform, allowing the interaction and the visualization of the different methods to achieve them. Although it is simulated, the environment presents a real situation, with the advantage of containing tools to help understanding the task. A greater challenge is to make the content appealing and visually stimulating.

The use of 3D graphical user interface has been proved useful in the learning methods, such as the computer-aided design (CAD), facilitating the development of the project, understanding and further education.

The analysis of the existing resources allowed the knowledge of the current spectrum of existing models which in conjunction with the needs survey conducted in this paper have helped to understand the shortages. Thus, based on this acquired knowledge, a proposal for a simulation model was made. The current available simulators for teaching present a user interface, which is sometimes less obvious as it is the reflection of several options, ultimately confusing and diverting the attention from the real objective and making handling complex. Therefore, the students usually find it difficult to work with, which makes the learning process a long and demanding task. To aid in this task, there is a study based on prototypes being developed in order to provide greater motivation and interest by the public. Features such as animations and three-dimensional statistical graphs are being thought of as options to facilitate the perception of the operation.

2 State of the Art

The current technology allows find a wide variety of simulation environments for different scenarios in education, for example: simulations in business education, simulation in assembly of computers and similar situations, training simulation in cars, plane and many others, but many of them do not take into account specific needs of particular users. Sometimes these environments are important tools with a strong impact on the development of these users that show difficulties at various levels and it can limit others practices in real context. Transforming students from passive observes of linear material to active operators of interactive content, these 3D simulation environments allow students to become immersed and involved.

One example of a tool the simulation environment that simulates the assembly of computers is the Cisco IT Essentials Virtual Desktop. It has a set of options which allows exploring the components, verifying knowledge or watching a demonstration. A different example is the design educational Game Based Simulation of ForgeFX to teaching players about everyday solutions.

Training and education have really changed in recent times. They have moved from classroom training to a continuously model where people learn at any time [1].

Increasingly new 3D technologies are being called on to enhance simulations, using various methods such as modelling, digitization and virtual reality to create high

quality and realistic digital content. This allows learners to experience resources that aren't normally available to them, whether it be due to their being in an inaccessible location or the element being in a fragile condition [2].

3 Simulation Environment

The diversity of applications involving simulated environments is growing. The simulation environments appear as a way to assist and facilitate the knowledge, to experience and analyze the different models. The increase of the use of this method entails some precautions derived from the complexity that they present due to the interaction. The understanding and the interaction with the system by an inexperienced user may not be a simple task since the selection, the manipulation and the orientation of objects may not be intuitive and so it is difficult to adapt.

Training and educational simulations are created in order to facilitate students or users learning. Because of its purpose, an educational simulation is an abstracted representation of the target system, which tries to show the complexity and realism of the element. In [3] have divided educational simulations in two main categories: operational simulations and conceptual simulations. Operational simulations are designed to facilitate the construction of practical knowledge, for example, in areas such as training. Conceptual simulations, on the other hand, are designed to facilitate conceptual knowledge construction on the part of the students. They are based on conceptual models, used within subject domain education, which simulate the relationships that exist between the variables of a real world system, while at the same time allowing the user to manipulate those variables [4]. The applications analyzed in this study are in both categories.

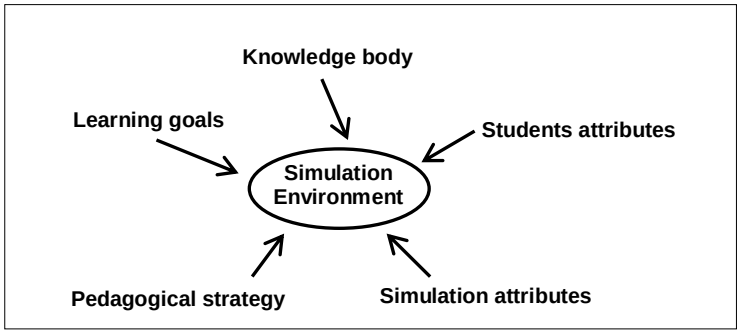

Figure 1 - Aspects of simulation environment training and education

In [5] "Interactive Storytelling: techniques for 21st Century Fiction", A. Glassner discusses what he calls the myth of interactivity, explaining that in recent

years the concept of interactivity was placed in a very high level, because even with the biggest interactivity possible if the environment where the user is interacting is not interesting, the immersion will not succeed. In this sense, one can find various applications that even holding good interactivity, were unsuccessful because they did not captivate the user's interest in exploring it.

Similar discussion can be taken into account in the context of education, where various softwares created for this purpose only reproduce the concept of the paradigm to be transmitted. In this case, we have to think not only about the user's interaction with the environment, but in the interest and the curiosity he may feel in exploring the environment offered.

There are several simulation tools available and within reach of a simple search on Internet. In general they have a set of options, which allow the user to know the components of the area, to check knowledge or to watch a demonstration.

The technique for selecting objects emerges as an important element in the performance of the user when interacting with the system.

4 Implementation and evaluation of results

When you want to build a three-dimensional environment with certain characteristics to be inserted into a product of education, a set of specific tools in the area of 3D is needed. Currently, we can find on the market multiple offers of 3D design software for free and also commercial versions that allow three-dimensional structures to develop from small to complex 3D environments [6].

The development of the whole simulation environment (Figure 2 and 3) presented here, was concerned with the need to create a simple and intuitive interface so that you can focus your attention on the systems studied and not on the learning of the use. In this case, the simulation environment to computer assembly, appear as a way to assist and facilitate the knowledge, experience and analyze the different models. The highlight of this simulation is derived from the complexity that it presents, due to the interaction.

Figure 2 - Interface of the simulation

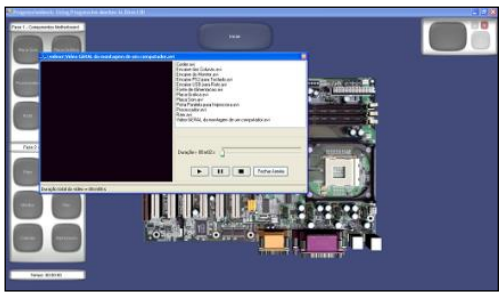

Figure 3 - Video help

The usual method in the evaluation of the 3D interaction is the users test, task-based. Therefore, in this experiment a group of users (32 students) from a local high school were selected to test 3D Simulation Environment in computers. Their main characteristics are presented in Table 1. This group interacted with 3D simulation environments making it possible to see their behavior regarding this application.

Data	Values
Number of subjects	32
Male subjects	25
Female subjects	7
Minimum age	14
Maximum age	23
Mean age	16,4

Table 1 - Students samples characteristics.

This is a stimulating environment for users concerning the visual level, based in the trend perceived in the context of training in the classroom. However, the interactive element appears to be a difficult component, because the features are leading many users with fewer skills to need assistance in completing the task. The possibility of demonstration is an enriching factor, according to the analysis done in the same context.

The applications analyzed in this study revealed similar points of view. Thus, the point of view of the observer is fixed, a strategy which saves the user from

handling complementary options at the same time that loaded the environment with options. However, in accordance with the results of the analysis, more experienced users, familiar with these environments, try these features in order to see greater detail but the users with special needs show greater comfort with this strategy that features more simplicity of the application.

The displacement of the objects is allowed through the use of the keyboard and the mouse; this last allows greater comfort for the user, as the results show. The selection allows the choice of elements and interaction with that object, this last being referred by the group survey as an important operation in the analysis of details in this type of simulation.

The prototype in the analysis tends to be an aid element and understanding of an appropriate methodology to develop in this study and therefore provides help in video format. To do so, the user needs to click the corresponding button. The help comes in context through the action performed at the time, trying to understand and meet the needs. On its turn, the user can view all the support videos, whenever convenient, which work as a tutorial.

A friendly and engaging environment makes learning accessible and it can determine its success, an opinion shared by several authors in the field of education and information technology. Thus, this prototype arises and tries to present only the necessary elements for the user to perform the task.

The purpose of this paper is to evaluate the usability, accessibility and functionality of an educational content developed in a three dimensional environment (Figure 4). Accordingly, the above prototype was designed with the aim of promoting new challenges to the public.

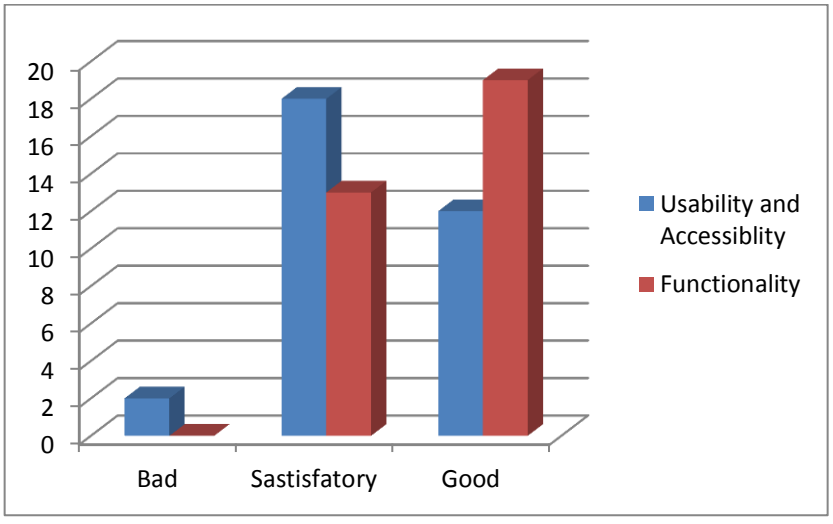

Figure 4 - Usability, accessibility and functionality of an educational

The quality of the environment exposed was evaluated as satisfactory. The navigation revealed to be an important point so, it requires greater attention. Regarding this aspect, the users sometimes showed difficulty in handling the object they wanted, but the taste by use of the model was verified.

The methodology is based in the observation of tasks, the comments about the difficulties and the analysis of the verification results. So, after identifying requirements, the prototype was developed for subsequent presentation to students. The information obtained can improve the solution presented.

The primary appeal of learn by doing simulations is that it can provide tremendously effective and engaging learning. The results obtained showed reactions to error on the part of users in the tasks required. The tutoring component provides feedback in the form of text, in order to help the students make the appropriate generalizations. Another option is a video clip provided, explaining a concept in more detail. This has been seen as an asset by users that revealed greater difficulties.

5 Conclusion

The 3D environments are present now in different situations, and one should check their behavior in the context of learning. The study comes after observing the conduct of students with this medium. The interest and commitment shown in the attempt to achieve the objectives pursued by these applications leaves its use as auxiliary tools open.

The use of a tridimensional environment allows the creation of an expectation and greater enthusiasm around the activity. The success of an application is related to the strategy and implementation used because the navigability and the interactivity appear as central elements to the user. A tool with a strong visual impact may discourage or make the understanding slower. On the other hand, the simplicity of an environment allows the user to focus and quickly assimilate the aim of the tool.

The ever-increasing realism, resulting of the advances in the area, allows users to be engaged and captivated and leaves the possibility for a greater exploitation of contents in 3D simulation environments in the learning process, especially for users with special needs, in the future.

In sum, users who have experienced the tools available in this study, specifically simulation environments for computer assembly and training simulators are satisfied with the presented environment, considered by them as pleasant and attractive, but less satisfied with the readability, clarity and consistency these for use of people with special needs. The guidance for these students in simulations should be very simple

The prototype presented highlights this desire allowing the use of a simple 3D environment. As future work, the project will continue the process of analysis and

evaluation within the school community so as to allow a final product according to their specific needs.

Also, in the future it is expected the possibility to develop other applications in different fields of knowledge for this public to facilitate learning. In this process there will be need for continued analysis of interactivity, usability and accessibility, this last aspect is important for the functionality and educational success to the student with special needs.

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