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### **Report Outline**

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# COMPARATIVE STUDY OF PLATFORMS FOR MULTI-USER VIRTUAL ENVIRONMENTS

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## ABSTRACT

Interest in science at high schools in the Western world, including Australia, has been declining for over a decade. In Australia, interest by school children in science is often lost around year nine and ten (middle school) as an emphasis on a curriculum full of content and theory replaces hands-on science investigation. While science laboratories should provide many opportunities for high school students to explore new environments and try out theories this has not been the case due to a number of formidable barriers such as physical challenges, safety and cost issues. Multi-User Virtual Environments (MUVES) have been considered to be an alternative to engage Australian high school students in science inquiry, and overcome such barriers by simulating the experience of real-life (outside the laboratory) interactions; yet, constructing these environments can be expensive and time consuming depending on the platform considered.

In this report, I provide a comparative study of existing platforms for MUVES which can be used to identify the right balance of functionality, flexibility, effort and cost for a given educational and technical context. A number of metrics are identified, described and used to enable the comparison. Through the comparative report of a range of potential platforms, I propose and justify my recommended platform for educational MUVE developers, which will ease their platform selection, and make MUVES deployment in the classroom more feasible.

**Keywords:** Multi-User Virtual Environment, platform

## **Section 1: Introduction**

Before moving onto the comparative study of platforms for multi-user virtual environments (MUVEs), in this section I discuss on the fundamentals of my study in order to provide the required basis for the project to be easily followed and understood. More specifically, I look at the setting of the problem along with the definition of the problem, the importance of solving it, and what my study intends to achieve and how it achieves it throughout my proposed project. Also, I present the glossary, abbreviations and flow of ideas to ease further reading on this paper.

I focus in this section on setting of the problem, in other words, providing the essential background information to establish my study in its wide context. Particularly, in Section 1.1, I discuss the current position of education in Australian high schools, and then provide an adequate overview about the gaps in it and the need for virtual worlds. These topics are infrequently discussed in research literature, yet they carry weight with the understanding of the problem.

I continue in Section 1.2 with discussions of the significance of a comparative study on MUVE platforms. In particular, I point out how my comparative study corresponds to the larger issues such as immense inequality in the standards of teaching and resources for science in Australian high schools. In this section, I specify the rationale behind the research project in order to justify the reason for my study.

I conclude in Section 1.3 with brief discussions of what my study aims to accomplish and how it accomplishes it during the whole of my proposed project. More specifically, in this section, I propose the general aims and specific aims of my study such as providing a justified recommendation targeting a range of platforms for the creation of MUVEs to encourage Australian high school students to engage science enquiry, and thoroughly review of shortlisted platforms respectively.

Through the whole of the report, I use commonly designated terminology and abbreviations related to the topic and technology, which may be unfamiliar to the readers of this study. For this reason, in Section 1.4, I provide a glossary and an abbreviation list to clarify the understanding of the words and encourage more precise comprehension of those subjects.

Finally, Section 1.5 provides an outline roadmap for the structure of the report, briefly describing what is discussed in the rest of the paper.

## **Section 2: Literature Review**

In this section, I provide a theoretical background for the comparative study of MUVE platforms, particularly concentrating on the current situation and historical information by involving previous findings before I commence on technical content of platform comparison. More specifically, I look at the description of MUVEs, their area of usage in

daily life, significance for teaching and learning, and their necessity for educational sector involving present implementations. Also, I discuss on the definition of agents, their significance and use in present technology and education, their impact on learning, and their effects on MUVES.

I focus in this section on describing virtual learning environments (VLEs) and MUVES. In particular, in Section 2.1, I briefly provide the definition for VLEs, nevertheless, I define MUVES in a detailed manner including their major features and components. These features and components have major importance when I discuss on platform metrics.

In Section 2.1.1, I expand on MUVES and discuss on their area of usage in present time. More specifically, I concentrate on the reasons of their utilization, where and how they are commonly used; such as their affordance of a common place for the members of an international organization with real-time video conferencing support in order to solve the cost and time issues of meetings.

I continue in Section 2.1.2 with discussions of the significance of MUVE technology in teaching and learning involving its use in teaching and learning matters. In particular, I provide the rationale of MUVES use in teaching and learning with real-world samples such as learning and teaching with MUVES in Open University and Open Habitat.

I conclude MUVE discussion in Section 2.1.3 with current uses of MUVE for education together with presenting samples such as SecondLife, AppEdTech, Quest Atlantis and River City. The educational MUVE model River City discussed here is an exact environment for engaging students in scientific inquiries, which is one of the main objectives of the project.

I also concentrate in this section on defining agents in conjunction with providing essential concepts that are related to MUVE models. More specifically, in Section 2.2, in order to understand the significance and benefits of agents in educational MUVES, I provide the basic concepts and definitions such as pedagogical agent, intelligent agent and multi-agent systems. These topics are frequently discussed in the platform comparison due to the communication and social abilities of agents, which have a crucial importance on educational MUVES.

In Section 2.2.1, I extend on agents and discuss on their area of usage in existing time. In particular, I discuss on what areas they are used, and what the agent technology offer its users; such as an animated pedagogical agent based system that is generated to improve the memory of children with epilepsy.

I continue in Section 2.2.2 with discussions of the agents in education. More specifically, I look at their significance on education, which areas of education they are utilized and how they are used; such as a multi-intelligent agent language learning environment that is designed to teach students to pronounce the words correctly. This topic has significance on understanding the use agents in education that is one of the key metrics used in platform comparison.

I conclude agent discussion in Section 2.2.3 with looking at the effects of agents on MUVES. In particular, I concentrate on the persona effect of an agent, in other words, the

impact of the existence of an agent in a MUVE environment. Also, I discuss the agent attributes such as gestures and facial expressions, and their impact on learning in MUVES. These topics frequently discussed in platform comparisons and recommendations part due to their significance on educational MUVES.

### **Section 3: Platform Comparisons**

This section examines the identified agent platforms in a technical detailed manner by taking the determined metrics into consideration. More specifically, I provide an introduction describing the meaning and the use of platforms together with the considered metrics for the comparative study. Then, I analyze each identified platform depending on the metrics given, and conclude the section with a summary.

I concentrate in this section on shortlisted platforms and their analysis in depth by taking the given metrics into account. Therefore, in Section 3.1, I define the meaning of platform and its area of usage. Section 3.1 has significance on providing the basic understanding on platforms, which is essential for further reading.

When analyzing and comparing a MUVE platform, the key element for the study is to identify the evaluation metrics depending on the goals of the project. In Section 3.2, I focus on the identification and definition on metrics. In particular, I provide the required definition for each metric that is taken into consideration through out the comparative study. The defined metrics in this section are regularly discussed in further reading and have crucial role for the report.

In Section 3.3, I specifically analyze and compare each identified platform considering the metrics given. More specifically, I first examine the particular platform depending on the metric considered, and then compare the functionality of the corresponding metric on another platform. The identified, analyzed and compared platforms are as follows:

Section 3.3.1: Active Worlds

Section 3.3.2: Sun's Wonderland

Section 3.3.3: The Open Cobalt

Section 3.3.4: Unity 3D

Section 3.3.5: Torque Game Builder

These comparisons are later on discussed in platform recommendations section, therefore, the results have major significance to come up with justified recommendations.

I conclude in Section 3.4 with brief discussions of how MUVE platforms can be evaluated, and some of the issues and problems that arise in examining a platform.

### **Section 4: Justified Recommendations**

The outcome of Section 3 provides the required platform comparison data to come up with justified platform recommendations. More specifically, In Section 4, I discuss on

platform comparisons in terms of technological and educational aspects, which may assist to minimize the development cost and time for MUVE generation to accommodate the specific needs of a developer by providing a baseline study.

I firstly concentrate on the technology-related platform recommendations. In particular, in Section 4.1 I examine the platforms in a technological perspective, and then provide recommendations accordingly to the technical comparison output such as ease of use, visuality, sound capability and programmability.

Secondly, I focus on the educational-related platform recommendations. More specifically, in Section 4.2, I study the platforms in an educational point of view, and then I come up with recommendations considering platform features for educational purposes such as usability for education and affordances for learning in an educational MUVE.

I conclude in Section 4.3 with a summary of platform recommendations merging the technological and educational aspects. One of the main objectives of the whole section is to propose a baseline study for developers to generate an educational MUVE that encourages high school students to science inquiry, which requires the combination of technology and education; therefore, in Section 4.3, I bring these two different aspects together while discussing on the platform recommendations.

## **Section 5: Conclusion**

To finalize the report, I firstly focus on the accomplished results of the comparative study on MUVE platforms. More specifically, in Section 5, I discuss on the highlights of the results that were undertaken formerly along with the minor details in the project that have major impacts to the entire results of the study. Secondly, I concentrate on the directions for future work, which may constitute a basis for further study. Thirdly, I evaluate the problems through out the platform comparison that influence the results. Next, I look at the benefits and the advantages of the study, and finally, I elaborate on the significance of my findings.