COMPONENT-BASED TOOLS FOR EDUCATIONAL SIMULATIONS

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ABSTRACT

e-Learning is an effective medium for delivering knowledge and skills. In spite of improvements in electronic delivery technologies, e-Learning is still a long way away from offering anything close to efficient and effective learning environments. To improve e-Learning experiences, much literature supports simulation based e-Learning. This thesis begins identifying various types of simulation models and their features that induce experiential learning. We focus on designing and constructing an easy-to-use Discrete Event Simulation (DES) tool for building engaging and informative interactive DES models that allow learners to control the models' *parameters* and *visualizations* through runtime interactions. DES has long been used to support analysis and design of complex systems but its potential to enhance learning has not yet been fully utilized. We first present an application framework and its resulting classes for better structuring DES models. However, importing relevant classes, establishing relationships between their objects and representing lifecycles of various types of active objects in a language that does not support *concurrency* demand a significant cognitive workload. To improve this situation, we utilize two design patterns to ease model structuring and logic representation (both in time and space) through a *drag and drop* component approach. The patterns are the *Delegation Event Model*, used for linking between components and delegating tasks of executing and updating active objects' lifecycles, and the *MVC (Model-View-Controller)* pattern, used for connecting the components to their graphical instrumentations and GUIs. Components implementing both design patterns support the process-oriented approach, can easily be tailored to store model states and visualizations, and can be extended to design higher level models through hierarchical simulation development. Evaluating this approach with both teachers and learners using *ActionScript* as an implementation language in the Flash environment shows that the resulting components not only help model designers with few programming skills to construct DES models, but they also allow learners to conduct various experiments through interactive GUIs and observe the impact of changes to model behaviour through a range of engaging visualizations. Such interactions can motivate learners and make their learning an enjoyable experience.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

e-Learning (i.e., technologies that use digital technologies to deliver and facilitate learning) is increasingly used in schools, higher education and training centres either to support distance learning or to complement the traditional classroom environment. Since it uses electronic media; e.g., the Internet, to support learning, this style of knowledge transmission eases traditional constraints on time, space and distance. The advantage to learners is that they can learn at anytime and anywhere. As a result, the use of e-Learning has grown rapidly throughout the world. However, this technology requires that learners themselves are responsible for gaining knowledge; a key concept of *learner-centred* education.

The teacher-student ratios either for primary, secondary or tertiary education in some countries (e.g., India, South Africa, Philippines, etc.) are still high. In India, the teacher-student ratio for secondary school was reported 32.7 in 2004 and 25.33 in 2010 (http://www.tradingeconomics.com). Although the ratios have slightly been improved in most countries during past few years, less time dedicated by teachers to the needs of each individual student demands attractive and interactive learning materials to promote and enhance their learning experiences. Learning materials that focus on *activities* (i.e., some degree of interaction) during the learning process are crucial in this and have proved to have more positive impacts on learning than static materials, such as numbers, texts and pictures (Holzinger & Ebner, 2003; Neumann, Page, Kreutzer, Kiesel, & Meyer, 2005; L. P. Rieber, 1996). Multimedia materials that allow content navigation that integrate texts, pictures, diagrams, sound and dynamic images (i.e., animations and movies) are increasingly integrated in learning environments. More recently, techniques that make learning more enjoyable and fun

The contents of the thesis is for internal user only

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