Chapter 11

3D Collaborative Virtual Environment to Support Collaborative Design

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ABSTRACT

Constructivist learning emphasizes students’ involvement in the learning process, how they become self-directed learners and actively engaged in the learning environment. This chapter describes Collaborative Virtual Environment (CVE) and its relevance to collaborative learning and constructivism. The authors developed the Collaborative World Design Tool (CWDT) software to evaluate the benefits of CVE for architectural design students. The CWDT was developed based on the Torque 3D Game Engine, thus the appearance and functionalities of the CWDT within the CVE are similar to computer game playing environment. In the experiment, subjects designed within the CVE, were either experts or novices, worked either individually or in pairs, and constructed a virtual building in a three-dimensional outdoor environment. Results show that working collaboratively within a CVE has great potential to increase performance where teamwork is faster than individual work, and overall provide a constructive learning environment.

INTRODUCTION

Teaching and learning strategy in educational institutions has been evolving and has altered the way teachers teach and students learn. Traditional teacher-centric method of teaching has been modified and enhanced with the introduction of computer technologies. Traditionally and conventionally, knowledge is communicated by the teacher through lectures in a classroom en-
environment, where students listen and take notes. Learning tends to be passive and students play little part in the learning process because focus is emphasized on the content of the teaching material, how much material has been delivered and how much the students have learned. On the contrary, in a constructivist learning paradigm, the learning process allows students to work individually or in small groups; rather than being passive recipients, explore, investigate and solve problems, and become actively engaged in seeking knowledge and information.

Technology provides opportunities to apply a constructivist approach to teaching and learning. Modern instructional strategy and tools for K-12 and higher education are becoming more convenient and sophisticated, whether in classroom or online. Teachers use the interactive whiteboards, online Blackboard systems, internet resources, Power Point slides, etc., to effectively extend the “used-to-be only in-classroom/laboratory, spoon-fed knowledge, long-established memorization of facts, principles, or procedures of learning traditions” into the paradigm of active learning, creative thinking, analysis and evaluation, and problem solving. As such, students must play an active part in their learning process and be self-directed learners who are actively engaged in constructing new meaning within the context of their current knowledge, experiences and social environments. Students become successful in constructing knowledge through solving problems that are realistic, and even more successful when working in collaboration with others (Bruner, 1996).

The foundations of constructivist learning approach come from the cognitive approach to psychology of learning (Jonassen et al., 1999), whereas the theories are rooted in Piaget (1952), Dewey (1966), Vygotsky (1978), Papert (1980), and Bruner (1985). Constructivist learning places emphasis on learners and proposes that learning is affected by context, beliefs and attitudes. Learners are encouraged to find their own solutions and to build upon their prior knowledge and experiences. Students learn by adding and fitting new information together with what they already know and actively construct their own new understanding. As such, students gain deeper understanding of the event or knowledge, thus constructing their own new knowledge and solutions to the given problems (Duffy & Jonassen, 1992; Jonassen, 1994). Jonassen et al. (1999) propose that problems or tasks given in a constructivist environment should present certain characteristics such as interesting, engaging, appealing, authentic, personally relevant, challenging to learners, and provide a physical simulation of the real world task environment.

Virtual Environments (VE), particularly systems that are embedded with collaborative features, also known as Collaborative Virtual Environments (CVEs), provide similar characteristics for a constructivist environment in the form of virtual settings. A CVE extends a standalone VE to include real-time collaboration, interaction and sharing of the same virtual space among users across a network. The need for collaboration, sharing of information, and exchanges of experiences, led to standalone VE applications being enhanced and developed into CVE applications. Generically, a VE application is considered a CVE when information sharing, 3D visualization and real world user-interaction and object manipulation are included as built-in features (Bryson, 1996; Schuckmann et al., 1999; Theoktisto & Fairen, 2005; Liston et al., 2000).

As virtual worlds, VEs and CVEs provide teachers the opportunities to create environments or virtual settings that support cognitive occurrence through the use of near-realistic visuals, audios, real-time interactions and manipulation of objects. Students are given the opportunity to explore and navigate the virtual worlds with authentic and purposeful contexts for practice and learning that are transferable to the real world. Andolsek (1995) suggests that since virtual worlds are totally engaging, they immerse the student
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