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Chapter XVI

Cave Automated Virtual Environment: A Supercomputer-based Multimedia System for Learning Science in a Science Center

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Abstract

A multimedia system based on the Cave Automated Virtual Environment is shown to be useful for learning science in the informal setting of a science center. Using the theme of water, concepts such as atomic structure, electron precessing, bonding and phase transformations have been used to provide a framework for scaffolding content in a dynamic manner among students. The high quality visualizations, immersive experiences, interactivity

and stereoscopic imagery in this virtual environment also contributes towards experiential learning, and it is suggested that this has constructivist implications.

Introduction

Traditional pedagogical environments such as classroom-based teaching continue to play useful and effective roles in delivering education to students. While it is perceived to have a number of disadvantages, for example, it is teacher-centric, it generally involves the passive assimilation of content by students, and it does not maximize learning efficiency in large groups, it still constitutes the bedrock upon which teaching and learning are premised. In more recent times, the role of science centers in complementing science teaching in schools has become important (Tan & Subramaniam, 1998, 2003a, 2003b, 2003c). By providing a learning environment in which knowledge transmittance occurs informally, considerable scope is afforded for students to expand their mental paradigms through participatory experiences in science exhibitions, large-format theatres, and other mass-based promotional activities. In many of the exhibits as well as in the programs shown in the large-format theatres, there is the mediation of technology to drive the learning experience. The communal dynamics inherent in these informal educational environments also provides a social context for learning.

In using technology to mediate the learning experience, multimedia systems offer tremendous potential. This is based on the recognition that the use of audio, video, and text technologies provide a stimuli-rich initiation into the learning process. Whereas traditional learning is dependent predominantly on oral narratives, the insertion of multimedia permits an expansion of the sensory dimension that is brought to bear on the learning process. And this has cognitive implications. Early versions of multimedia systems were restricted to programs on monitor screens, which provide the necessary audiovisual experiences through computer-generated graphics (Bryson, 1992). In later versions, there was the availability of 3-D images, but these need to be relished using 2-D media, that is, a desktop monitor screen in conjunction with stereographic glasses. While permitting navigation capabilities through the learning worlds generated, they do not have the capability to foster immersive experiences.

Technological advances in computational processing, image rendering, and scientific visualization have contributed immensely to the advent of more complex multimedia systems, notably virtual reality (Bryson, 1996). This has allowed the creation of compelling learning experiences that are participatory in