Immersive Visualization in K-12 Education

Derek C. Eggers*
University of Kentucky
Center for Visualization and Virtual Environments

Joan M. Mazur†
University of Kentucky
College of Education

Cindy H. Lio‡
University of Kentucky
College of Education

1 Abstract

In this presentation we review prior research of immersive visualization technology for K-12 educational settings, discuss current research, affordable technology and effective strategies to support K-12 education with immersive displays. Open dialog is encouraged among participants to identify and discuss challenges, solutions, and explore future directions. Costs of immersive visualization displays, invasiveness of devices, interactivity, mobility and re-deploy ability of displays, selecting appropriate content applications, content development, and integration with teachers and curriculum are among topics addressed. Present work at the University of Kentucky's Center for Visualization and Virtual Environments is featured using commodity based collaboratively rendered environments suitable for educational settings and diverse populations.

2 Introduction

The Center for Visualization and Virtual Environments (CVVE) at the University of Kentucky is engaged in an effort to research application of immersive visualization technology in several fields including medicine, engineering, military training and command, training, and K-12 education. As part of the process researchers reviewed 24 published articles documenting 16 projects from 1992 to 2003 developed at 6 different institutions. A summative overview of major findings is presented. Following, we discuss current research and future directions.

3 Recommendations from Prior Research

During the review of literature we were not surprised to find the amount of prior research in K-12 applications of immersive visualization fairly sparse. Both the cost of immersive displays, and the effort required to produce content and implement in a school setting are prohibitive. Nevertheless, we did find documented research that informs our pursuit at several institutions and various project names including the EVL (Electronic Visualization Laboratory) at the University of Illinois Chicago, the HITL (Human Interface Technology Lab) at the University of Washington, Science Space at George Mason and University of Houston, and finally at the Virtual Reality and Education Laboratory at and East Carolina University.

While there is evidence of at least the pursuit of cognitive learning gains from various visualization techniques, the real outcomes in many of the disciplined forms of research in the K-12 setting are more pragmatic [Roussos et al. 1999]. Some of the outcomes indicate findings that may sound obvious to many, but are very important when embarking on an endeavor. Not only are significant financial resources at stake, but the development of research agendas are affected. More importantly the opportunity to influence young and developing minds is a key consideration. A summary of some of the most practical outcomes include the following recommendations: (1) integrate the visualization facility into not only the school's physical facility, but the teacher's pedagogical style, and state's educational standards [Johnson et al. 1999]; (2) minimize the use of complex and cumbersome devices such as head-mounted displays, data gloves, and complex user interfaces that may be appropriate for adults, scientist and engineers, but not for diverse populations of younger users; and (3) develop content and systems capable of highly interactive and collaborative learning of multiple learners, not just one driver and multiple observers. One of the most meaningful implications of prior research to the agenda at the CVVE is a recommendation to research commodity-based display solutions [Moher and Johnson 2001] such as low-cost PC's, DLP projectors, and game console adapters. We believe this may be heavily leveraged in both commercial and educational applications.

4 Current Research and Development

Current research and development at the Center includes: Learner Articulation -- an observation and analysis of engineering students exploration in an immersive visualization display to understand concepts in basic fluid dynamics; and automatic calibration of large area immersive displays using commodity based hardware.

5 Future Directions and Discussion

Future research agendas at the CVVE include support of: lowering the costs of immersive visualization displays, minimally invasiveness (or non-restrictive) devices, increased interactivity, mobility and re-deploy ability of displays, selecting appropriate content for immersive visualization applications, immersive visualization content development, and integration with teachers and curriculum. Please participate and share your thoughts in our presentation.

JOHNSON, A., MOHER, T., OHLSSON, S. 1999. The Round Earth Project - Collaborative VR for Elementary School Kids. In the SIGGRAPH 99 conference abstracts and applications, ACM, 90-93.

MOHER, T., JOHNSON, A. 2001. First Person Science Inquiry 'in the Field' In *Proceedings of IPT/EGVE* 2001. 131-140.

ROUSSOS, M., JOHNSON, A., MOHER, T., LEIGH, J., VASILAKIS, C., AND BARNES, C. 1999. Learning and Building Together in an Immersive Virtual World In *Presence* 8, 3, 247-263.

*e-mail: deggers@engr.uky.edu
†e-mail: jmazur@pop.uky.edu
‡e-mail: chlio2@uky.edu