# Using Virtual Reality to Construct Knowledge

*Steve Downey*
*Academy for Excellence in Engineering Education*
*University of Illinois at Urbana-Champaign*
*463 Grainger*
*1301 W. Springfield Avenue*
*Urbana, IL 61801*

Ever wonder how people come up with the solutions that they do? Have you sat there and asked yourself, "what were they thinking?!?" Concept maps, and closely related cousins such as semantic networks, provide some insight into the thought organization process, albeit in a limit manner. Concept maps are two-dimensional illustrations of how individuals cognitively organize concepts and relationships within a domain. However, the inherent limitation of being two-dimensional inhibits existing knowledge construction tools, such as semantic networks and concept maps, from assisting students in developing the cognitive skills necessary to identify and integrate multiple perspectives of understanding required by the growing complexity and ill-structuredness in the world.

The application of virtual reality technologies in the students' knowledge construction process, however, may provide learners with a tool for representing multiple perspectives of a domain as well as the interrelationships of concepts within that domain as they change from perspective to perspective. To determine if this potential exists, this work-in-progress attempts to assess the viability of virtual reality markup language (VRML) as an innovative, educational tool for creating knowledge maps for use in the learning process. More precisely, this study seeks to determine if and how students' development of three-dimensional concept maps using VRML influences their learning and integration of multiple perspectives in ill- and well-structured domains. In the process, the study will attempt to prove/disprove the following hypotheses:

$H_{01}$: There is no difference in the effect of two-dimensional versus three-dimensional concept mapping on students' ability to learn relationships between concepts;

$H_{02}$: There is no difference in the effect of two-dimensional versus three-dimensional concept mapping on students' ability to integrate multiple perspectives of a content domain; and,

$H_{03}$: There is no difference in the effect of two-dimensional versus three-dimensional concept mapping on students' ability to structure relationships between concepts in well-structured versus ill-structured content domains.

Should the findings indicate that multidimensional mapping enhances learning, integration, and application of multiple perspectives/interpretations of a domain, the implications of this study could impact teaching methods in and out of the field of engineering— especially in fields requiring a high degree of problem solving. By using virtual reality technologies, such as VRML, learners could better identify and understand concepts and how they are perceived by individuals who may interpret these same concepts from different perspectives.

The study's design is a multi-factor, multiple measures configuration in which students create concept maps in both two- and three-dimensions. The order in which the maps were completed was determined randomly. At the same time that students were assigned to their first treatment group, they completed a benchmarking instrument indicating the experience levels with: concept mapping theories, the technologies used in the study, the content to be learned, and their spatial aptitude. The development of the maps within each of the treatment groups occurred over the course of six weeks, three weeks per treatment. The content upon which the maps were developed came from readings completed by students each week during their treatment groups. The completion of the first map was followed by an assessment of the students' learning related to their weekly readings. This marked the end of the first treatment. Upon completion of the first treatment, students switched treatment groups and performed the process over again, this time using readings from a different, but related domain, as well as a new mapping environment. After finishing both treatments, students completed a questionnaire soliciting their thoughts, perceptions, concerns, etc. related to the two mapping environments. The assessments and the maps, along with the benchmarking instrument and post treatment questionnaire, will be analyzed in the coming weeks using a multi-covariate analyses, supplemented by qualitative theme and comment analyses.

Excerpts from the final report, which should be completed in March, will be available via the Academy for Excellence in Engineering Education Web site at http://ae3.cen.uiuc.edu/vr-study/.