Chapter IV

Taking University Science Education Online

We search for ways to see ourselves. The computer is a new mirror, the first psychological machine. Beyond its nature as an analytical engine lies its second nature as an evocative object

— Sherry Turkle (1948)

While distance education in various forms has existed for many years, the exponential growth of computer-based, especially Web-based, education has presented a challenge for instructors who learned to operate in a traditional classroom environment. Not only must they design engaging, effective learning modules with authentic assessments, promote interaction and gauge understanding throughout the term, they must now do so without being able to see their students and without the students’ ability to participate in typical classroom activities (Edelson, 2001). This is especially problematic for subject areas such as science and mathematics, where demonstration and experiential activities are essential. Despite these complexities, there is tremendous potential for effective, engaging science instruction through distance learning, but also a pronounced, crippling disconnect between the technology being used in other disciplines—computer modeling, for example—and
instructional design. Online faculty and instructional designers typically do not collaborate with computer science colleagues who have the equipment and cutting edge expertise required to design sophisticated learning modules. Such sophisticated modules would move beyond the context and resource focused modules that are common—and acceptable, while not ideal, for citizen science-level learning—to those that provide tools and scaffolds that meet the needs of all science learners. A wide range of relevant technologies exist, including games, simulations, modeling, virtual instrumentation, and animation (Elgamagl, Fraser, & McMartin, 2005; Kin, 2004; Young-Suk, 2004). This chapter presents original research that investigates current uses of these Web-based instructional technologies.

Survey of Undergraduate Distance Science Education (SUDSE®)

Teaching science online can be frustrating, especially when a student mislabels the coracoid process as the trapezius muscle because of two-dimensionality, when a long thread of conversation develops around a mistaken idea posted between instructor logins, or when a colleague steeped in radical constructivism insists that all of science can be taught inductively. In response to these and similar frustrations, and dissatisfaction with extant models that require undue extrapolation to meet the needs of science education, we developed a dual-stage investigation with two goals: to benchmark current practices in Web-based science education at degree-granting institutions of higher education and to develop a best practices, didactic model for Web-based science courses integrating the results of the benchmark study.

Background

The strategies by which instructional design can be effectively applied to the distinctive pedagogical issues of teaching science online are a nascent area of educational research. In the past decade, a handful of books have reviewed pedagogical and technological aspects of distance science education such as the classic Open Science: Distance Teaching and Open Learning of Science Subjects by Ross and Scanlon (1995) and the edited volumes Internet Environments for Science Education by Linn, Davis, and Bell (2004) and Mediating Science Learning through Information and Communications Technology by Holliman and Scanlon (2004). Likewise, over the last decade there have been various articles published in education journals and disciplinary science journals describing efforts, usually course-specific initiatives, to develop Web-based science activities or courses.

There has been no nation-wide benchmark study to determine the conventional and best practices for Web-based science instruction in the U.S. community colleges and universities. Hence, knowledge of emerging Web-based science practices in the U.S. has been patchy at best. For example, little is known about what is actually going on in Web-based science courses at the level of the disciplines within Liberal Arts and Science (e.g., biology, chemistry, physics, geology) or the corresponding course design features (e.g., course materials,
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