

Chapter 3

Relevant Issues that Challenge the Designing of Transformative, Liberating Online Science Courses

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ABSTRACT

Science as a discipline has gone through many paradigm shifts, both in terms of scientific knowledge and science pedagogy. One recent trend is the movement of science courses into an online environment. While this shift started as supplemental instruction, a movement in education is to offer entire science courses, normally taught in a face-to-face format, online. Moving science instruction into this type of environment illuminates many challenges in science education to a different and critical level. These challenges include issues in equity, accountability, identity formation, and appropriate pedagogical practices. The authors explore these challenges in general for online learning and specifically for teaching science online. It is clear that these issues, while heavily researched in face-to-face science instruction, have not been seriously considered in the online format. Currently it appears that those teaching science online have simply ported their face-to-face course without considering the fact that instruction needs to be changed when teaching online.

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INTRODUCTION

Online education has permeated higher education as a method to reach traditional and non-traditional students who may not have the means to attend a university in person. Many science courses have been transformed into online courses. However, given the nature of science, one must ask what challenges are faced when presenting science in an online format. This chapter will examine different issues for online science education at the university level. We will discuss the effects of online science education on equity, accountability, pedagogy, identity, the science process, and on science itself. We will conclude with the author's reflections on online science instruction and roles. These discussions will be addressed through a transformative model of distance education (Pea, 1994) as applied to science education.

Equity in science and online education can mean many different things. Major issues in equity that affect online science education include: gender, race, ethnicity, sexual orientation, culture, and accessibility (including geographic, technological, and disabilities). Many organizations have discussed the goal of science education to be "science for all" (e.g. the National Research Council [NRC], the National Science Teacher Association [NSTA], the American Association for the Advancement of Science [AAAS]). Through a discussion of equity in online science education this chapter examines how teaching science online promotes and/or impedes the "science for all" notion. Related to this, there is concern about whether there is equity between students who take a course in an online format versus those who take the course face-to-face or in a hybrid format (Smith, Ferguson, & Caris, 2002). The section on equity will also address the issue of equity for students in each of these different course formats. Finally, teaching science in an online format is not limited to one geographical area. Therefore the issues of diversity, multiculturalism, and globalization must be examined (Carter, 2005;

Germain-Rutherford & Kerr, 2008). These issues are addressed specifically as they are related to teaching science through online education.

In addressing accountability this chapter examines challenges to conducting an inquiry-based science course through an online format. Science education research has shown that science is best learned in an inquiry-based learning format; however, it is not clear how students can be held accountable in an online course when there is no one to oversee their activities. Problems that may arise in conducting an online science course include determining whether the person turning in the work is the person registered for the course and whether the students complete the activities or laboratories as written (e.g. has data or information been fabricated?). Through the exploration of issues in accountability this section includes methods that have been shown to work for keeping students accountable for conducting their science activities by involving the students in the process and personally investing themselves in the activities. We also advocate for the use of alternative documentation (e.g. pictures, videos, webpages) to demonstrate that activities or laboratories are completed as required. Finally, this section explores the instructor accountability for the development of the course in realizing that the implementation of an online course is not a true port of the same face-to-face course.

Science education research has shown that learning science through inquiry is the most effective pedagogy (Barba, 1998 & Lawson, 2010). However, there are questions regarding whether or not this translates into an online format. An online science course cannot be simply a correspondence course. Therefore we explore the transformative process necessary to provide an online education that is "equal" to a face-to-face version of the same science course. The use of best practices for teaching science in an online format, such as the appropriateness of virtual online representations and models, are explored throughout this section. It is also acknowledged

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