Chapter 32
Providing Elementary and Middle School Science Teachers with Content and Pedagogical Professional Development in an Online Environment

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ABSTRACT

There is a great need to provide science teachers with on-going and relevant professional development, but access to such opportunities can be challenging due to time, distance, and budget pressures. Online courses and programs can provide alternatives to address these challenges. This chapter presents approaches, findings, and recommendations for online professional development of elementary and middle school science teachers based on a case study of an online science education course and an online chemistry course. Three themes are discussed: the ability to incorporate inquiry-based teaching and learning in online environments, the importance of online discourse and reflection, and the role of linking theory with practice. Teacher participants reported increased experience exploring content via inquiry, felt actively engaged with their peers as they constructed their knowledge, and expected to adapt inquiry-based activities in their classrooms as a result of these online courses.

INTRODUCTION

Good teaching matters! According to the NAEd Education Policy White Papers Project, "there is persuasive evidence that students benefit from high quality instruction and that these benefits are cumulative for students who have good teachers for several years" (Wilson et al., 2009, p. 1). Thus, there is a great need to provide science teachers with on-going and relevant professional develop-

DOI: 10.4018/978-1-4666-7363-2.ch032

ment (PD). The Glenn Commission report, *Before It's Too Late* (Department of Education, 2000), states that better mathematics and science teaching is grounded in improving the quality of teacher preparation and making continuing PD available.

Having access to PD programs can be problematic. Teachers must deal with time and travel constraints and budget pressures, leaving little opportunity to pursue PD. However, online courses and programs can allow teachers to fit coursework into their schedules as they can be accessed at any time, from any place (Asbell-Clarke & Rowe, 2007). For some teachers, online coursework may be the only option for furthering their subject knowledge (McNall Krall, Straley, Shafer, & Osborn, 2009).

There is growing evidence supporting online PD (Clary & Wandersee, 2009; Davis & Snyder, 2012; McNall Krall et al., 2009), but developing an effective course involves more than putting notes and assignments online. This chapter will describe considerations and approaches for developing online PD courses for science teachers and how two online courses engaged teachers in inquiry, meaningful discourse, and making connections to their classroom practice.

BACKGROUND

The Importance of Inquiry-Based Professional Development

Science is not simply a collection of facts to be memorized and explained, but rather, it is a way of thinking and approaching real-world problems. Scientific inquiry is described as:

...a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. (National Research Council (NRC), 1996, p. 23)

Students who engage in scientific inquiry use many of the same activities and thinking processes as scientists, yet these activities and processes are not always familiar to teachers (Olson & Loucks-Horsley, 2000). Since teachers' knowledge, experiences, and beliefs greatly impact what takes place in the classroom, teachers should learn content and pedagogy through engagement in activities that mirrors the approaches it is hoped they will bring into their classrooms (NRC 1996; Loucks-Horsley, Stiles, Love, & Hewson, 2010).

PD should incorporate science practices that promote teachers' understanding of science content and inquiry-based approaches (Capps, Crawford, & Constas, 2012). As with students, teachers learn best by doing science, investigating and constructing their understandings. Teachers should have significant and substantial involvement in laboratory experiences where they actively investigate phenomena, devise research questions, design procedures, collect and analyze data, and report findings (NRC, 1996).

PD that engages teachers in authentic research experiences and provides opportunities to develop inquiry-based lessons, may be key in assisting teachers in bringing such approaches to their classrooms (Capps et al., 2012). There is a need for rigorous, research-based PD for science teachers that empowers them to utilize the most effective science teaching methods, including unstructured problem-solving and inquiry-based learning (National Science Board, 2010).