Chapter 20

Engaging Teachers in Science Practices and Discourse Through Online Professional Development

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ABSTRACT

Online professional development courses and programs provide science teachers with ongoing and relevant professional development opportunities that overcome time, distance, and budget pressures. To demonstrate the effectiveness of this approach, this chapter presents a case study of elementary and middle school teachers enrolled in two online courses in chemistry and science education. Based on this work, three themes emerged: 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. Specifically, 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! In the National Academy of Education’s seminal Policy White Papers Project, which addresses the future of teacher education, the authors state “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 development (PD). The landmark Glenn Commission report, Before It’s Too Late (U.S. 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. The objectives of this chapter are to provide considerations and approaches for developing online PD courses for science teachers; present a case study for how two online courses engaged teachers in inquiry, meaningful discourse, and making connections to their classroom practice; and discuss implications, recommendations, and future directions for the online professional development of science teachers.

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. The Next Generation Science Standards (NGSS) (2013, vol. 2) note the value of “not only know[ing] science concepts, but also that students can use their understanding to investigate the natural world through the practices of science inquiry” (p. 48). The NGSS focus on learners’ engagement in science practices to investigate core ideas to better understand how crosscutting concepts “help describe phenomena across many science domains” (Windschitl & Stroupe, 2017, p. 251). Eight practices are noted as “essential for all students to learn”: 1) Asking questions, 2) Developing and using models, 3) Planning and carrying out investigations, 4) Analyzing and interpreting data, 5) Using mathematics and computational thinking, 6) Constructing explanations, 7) Engaging in argument from evidence, and 8) Obtaining, evaluating and communicating information (NGSS Lead States, 2013, vol. 2, p. 48).

As noted in A Framework for K–12 Science Education (NRC, 2012), “Engaging in the practices of science helps students,” and, we would argue, teachers as well, to “understand how scientific knowledge develops. . . . The actual doing of science. . . can also pique [learners’] curiosity, capture their interest, and motivate their continued study” (pp. 42–43). They can then see how science can contribute to the solution of the problems and challenges that society faces daily.

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 (National Academies of Sciences, Engineering, and Medicine [NASEM], 2015). 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 hoped-for approaches they will bring into their classrooms (NRC, 1996; Loucks-Horsley, Stiles, Love, & Hewson, 2010).

As with students, teachers learn best by doing science, investigating and constructing their understandings. Whereas the NGSS makes clear that it does not address what teacher PD should look like (NGSS Lead States, 2013, vol. 2), the National Science Education Standards (NRC 1996) argued that
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