

Assessment of Professional Development and Research-Based Instructional Strategies for Instructors of Online Undergraduate STEM Courses

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ABSTRACT

Professional development (PD) programs for faculty are critical for improvement of STEM instruction. Little research exists on the impact of such programs in the online environment. This article reports the pilot study results of an observation protocol (OP) on the development of an online PD program for STEM faculty grounded in research-based instructional strategies (RBIS) and the development plan for the program. The RBIS-based OP in place at Franklin University will be used to identify and assess online STEM instructors' teaching practices before and after the PD program. Pilot study results suggested that the OP yields valid and reliable evidence of STEM faculty's RBIS usage. Approximately 80 STEM course sections will be observed using the OP with data collected pre- and post-PD (3 year period). The mixed-method data will be analyzed by university researchers in conjunction with a community research partner. This project will test the success of an online professional development program with RBIS for higher education STEM faculty, aid determination of which RBIS can contribute most effectively to improving student outcomes and produce the first robust evidence of the impact of an online PD for STEM faculty.

KEYWORDS

Active Learning, Observations, Online Faculty, Professional Development, Research-Based Instructional Strategies, STEM

INTRODUCTION

The United States lags behind other nations in professional proficiency in the sciences, technology, engineering, and mathematics (STEM) (Bergeron & Gordon, 2017; DeJarnette, 2012; Jordan, 2014; National Science Foundation, 2015). Institutions of higher education must find solutions to improve the quality and teaching practices of STEM educators (American Association for the Advancement

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of Science, 2013; Committee on Science, Engineering, Medicine, and Public Policy, 2016). Derting et al. (2016) noted, “Faculty professional development programs are critical components of efforts to improve teaching and learning in the STEM (Science, Technology, Engineering, and Mathematics) disciplines...” (p. 1).

Following from these observations, this paper reports on an Observation Protocol (OP) for online professors and development of a research-based professional development program grounded in research-based instructional strategies (RBIS) (Borrego, Cutler, Prince, Henderson, & Froyd, 2013; Froyd, 2008). The population will be undergraduate online STEM faculty at Franklin University, Columbus, Ohio.

Research-Based Instructional Strategies

Since the late 20th century, leading educational researchers, such as Gagne (1985) and Merrill (2002), have observed that active learning strategies lead to more engaged learners and, therefore, improved learning will take place. Such strategies are vital for STEM-based instruction (Avery, 2013; Borrego et al., 2013; Dede & Eisenkraft, 2016). Investigators (Borrego et al., 2013; Freeman et al., 2014; Froyd, 2008) have advanced the acceptance of active learning strategies teaching in undergraduate STEM courses through extensive research identifying the characteristics of these strategies (Early, Rogge, & Deci, 2014). The strategies include approaches such as inquiry learning, problem based learning, and collaborative learning, thus providing much needed support for the veracity of these strategies. As a result of this clarifying research, undergraduate STEM faculty are being challenged to integrate more active strategies into their STEM courses (Borrego & Henderson, 2014) rather than many commonly used passive strategies (Bonura, Bissell, & Liljegren, 2016).

Professional Development Programs for STEM Instructors

Colleges and universities often employ full-time and part-time faculty who are content experts, and often not professionally trained educators. This lack of training adds to the complexity of providing effective STEM instruction. Shulman (2005) reported that faculty rarely receive direct preparation to teach. This omission intensifies the imperative for institutions to address the gaps in faculty knowledge and skill regarding implementation of teaching pedagogies. A major mode is faculty professional development programs (Ebert-May et al., 2015; Whittaker & Montgomery, 2014).

Inclusion in professional development for STEM faculty is strongly advocated (Avery, 2013; Baker et al., 2014). Studies of PDs for instructors at various levels with various class sizes have shown improvement in self-efficacy and student-centered instructional strategies, as well as student improvement (Derting et al., 2016; Ebert-May et al., 2015; Ring, Dare, Crotty, & Roehrig, 2017). With the significant growth of underrepresented populations enrolled in Franklin University online undergraduate STEM courses, the university can inform teaching across the higher education STEM spectrum. This goal aligns with Whittaker and Montgomery’s (2014) observation that “developmental support for recognizing or developing individual faculty initiatives that support the building of diversity and promote the success of individuals from diverse backgrounds at all career levels are needed” (p. 270).

This brief review indicates that implementation of PDs improves STEM faculty use of RBIS that are student-centered and promote active student engagement. The studies cited provide ample evidence of the pedagogical benefits of PDs, although implementations took place in traditional campus settings. This paper describes a protocol to evaluate the effects of STEM instructors’ PDs exclusively in an online environment.

Barriers to Professional Development

Past attempts to stimulate instructional change through PD in higher education have fallen short or have produced questionable long-term impacts (Labov, Singer, George, Schweingruber, & Hilton, 2009). Even when universities offer faculty development opportunities, after training many faculty

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