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Feature
Current Insights

Recent Research in Science Teaching and Learning

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This feature is designed to point *CBE—Life Sciences Education* readers to current articles of interest in life sciences education as well as more general and noteworthy publications in education research. URLs are provided for the full text of open access articles and for the abstracts of articles not freely available. To draw attention to a range of knowledge about science education and highlight well-studied topics in science teaching and learning, *Current Insights* alternates between featuring a variety of current literature and a number of articles on a particular theme. This themed issue focuses on undergraduate science education reform by highlighting research on barriers to reform, recommendations for mitigating or surmounting these barriers, and cases where barriers have been overcome. The primary thrust of these articles is the study of the successes and challenges of adopting inquiry-based instructional strategies. Although questions surround the idea of inquiry (Anderson, 2000), one of the most widely cited definitions is offered in the *National Science Education Standards*:

> "Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. "(National Research Council [NRC], 1996, p. 23)

1. Brown, P. L., Abell, S. K., Demir A., and Schmidt, F .J. (2006). College science teachers' views of classroom inquiry. Sci. Educ. *90*, 784–802.

   [Not open access. Abstract: www3.interscience.wiley.com/journal/112621192/abstract]

In this phenomenographic study (i.e., research conducted to understand participating individuals' conceptions of a phenomenon), Brown and colleagues aim to understand undergraduate science faculty's views of inquiry-based instruction. The participant pool was selected purposefully to span disciplines (e.g., biology, chemistry, geology, etc.) and institutions (e.g., two-year college, private liberal arts college, research extensive university, etc.). In addition to characterizing instructors' beliefs about inquiry, the investigators identified their perceptions of the constraints to implementing inquiry-based instruction, including factors related to logistics (i.e., time, class size, physical facilities) and students (i.e., their motivation, science knowledge, math ability, laboratory skills). Notably, faculty in this study held "all-or-nothing" views of inquiry-based instruction such that they expected students to "take charge of all phases of an investigation" rather than assuming varying levels of responsibility at different points during an investigation. For example, students could be given an experimental design or dataset (i.e., less responsibility) that they then would use to build explanations that they support with evidence from the dataset (i.e., more responsibility). The investigators recommend faculty development that encourages a range of inquiry-based instruction, from more structured to more open or full inquiry. Resources that describe the range of classroom inquiry include Buck *et al.* (2008) and NRC (2000).

2. Kahveci, A., Gilmer, P. J., and Southerland, S. A. (2008). Understanding chemistry professors' use of educational technologies: an activity theoretical approach. Int. J. Sci. Educ. *30*, 325–351.

   [Not open access. Abstract: www.informaworld.com/smpp/content~content=a779512973]

As Kahveci and colleagues note, universities expend significant resources to equip classrooms with technology with the aim of improving undergraduate learning, with little empirical evidence regarding how technology is used in teaching practice. In this study, the investigators aim to understand the ways in which faculty use technology to teach undergraduate chemistry by taking a cultural-historical activity theory approach. In other words, they represented chemistry education as an interacting system of "subjects" (i.e., individual faculty) and their "community" (i.e., department, faculty in other departments interested in chemistry learning, etc.), who direct their activities toward an "object" (i.e., the teaching of chemistry) that leads to an "outcome" (i.e., chemistry learning). This approach enabled Kahveci and colleagues to develop hypotheses about the relationships among components of the system, including where there might be "contradictions." For example, analysis of instructor interviews, course handouts, related web-

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sites, exams, and student work revealed a contradiction between one instructor's interest in using technology in the classroom and his department's uneven support for doing so. Other contradictions included disconnects between the culture of teaching chemistry in the department and instructional approaches supported by chemistry education research and between the "rules" of the system (e.g., establishing large class sizes, poor design of classrooms, etc.) and the teaching and learning of chemistry (the object).

3. Henderson, C., and Dancy, M. H. (2007). Barriers to the use of research-based instructional strategies: the influence of both individual and situational characteristics. Phys. Rev. ST Phys. Educ. Res. *3* (020102), 1–14.

   [Open access: http://prst-per.aps.org/pdf/PRSTPER/v3/i2/e020102]

In this exploratory study, Henderson and Dancy aim to identify the factors that contribute to the failure of undergraduate physics faculty to adopt research-based instructional materials and practices. Of the five faculty whose interview data were analyzed, all appeared to practice more traditional instructional approaches while holding more alternative conceptions of teaching. For example, all of the instructors noted that it was valuable for students to learn to solve problems and that students best demonstrate their problem-solving skills by solving novel problems. Yet, none of the instructors taught problem-solving skills or offered opportunities for students to solve novel problems. The instructors in this study attributed this disconnect to a number of situational barriers, including student resistance, departmental norms, and time constraints. The investigators propose that situational constraints rather than instructor knowledge or beliefs are the dominant factor in preventing widespread undergraduate physics education reform. They recommend greater focus on understanding and modifying situational barriers rather than changing the conceptions of individual faculty. See also Henderson and Dancy (2008).

4. Park Rogers, M. A., and Abell, S. K. (2008). The design, enactment, and experience of inquiry-based instruction in undergraduate science education: a case study. Sci. Educ. *92*, 591–607.

   [Not open access. Abstract: www3.interscience.wiley. com/journal/117884350/abstract]

Park Rogers and Abell describe the design and practice of an inquiry-based interdisciplinary science curriculum for non-science majors to illustrate what inquiry looks like in an undergraduate classroom and characterize students' responses to the experience. Data sources included field notes from classroom observations, instructor and student interviews, and course materials (e.g., syllabus, laboratory manual, quizzes). Students noted that the unique aspects of the course were its emphasis on how science is done and the social nature of learning as well as its focus on "big ideas rather than the factoids." The article includes a detailed description of the enactment of inquiry-based instruction that nicely illustrates how it is achievable in the college classroom.

5. Silverthorn, D. U., Thorn, P. M., and Svinicki, M. D. (2006). It's difficult to change the way we teach: lessons from the Integrative Themes in Physiology curriculum module project. Adv. Physiol. Educ. *30*, 204–214.

   [Open access: http://advan.physiology.org/cgi/content/full/30/4/204]

Silverthorn and colleagues describe the development and study of "active learning" physiology curricula and professional development designed to address two factors thought to impede undergraduate science education reform: instructor knowledge about teaching methods and lack of time to develop curricula. Based on results gathered using a classroom observation rubric, they found that faculty who used the active-learning curricula were more likely to change their instructional practices than those who did not, regardless of their participation in professional development. In the course of conducting the research, the investigators determined that faculty attrition from the program approached 50%. This outcome prompted them to conduct an interview-based evaluation to identify contributing factors that they categorized as institutional, departmental, personal, and project design obstacles. See also Silverthorne (2006).

I invite readers to suggest current themes or articles of interest in life science education as well as influential papers published in the more distant past or in the broader field of education research to be featured in *Current Insights*. Please send any suggestions to: Erin Dolan (edolan@vt.edu).

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