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 abstracts or full text of articles. For articles listed as “Abstract available,” full text may be accessible at the indicated URL for readers whose institutions subscribe to the corresponding journal. Although the major goal of this feature is to highlight original research, the following is a series of meta-analyses and reviews published in recent months that warrant attention.

1. Bennett, J., Hogarth, S., Lubben, F., Campbell, B., and Robinson, A. (2009). Talking science: the research evidence on the use of small group discussions in science teaching. *Int. J. Sci. Educ.* iFirst article (no volume or page numbers available yet).

[Abstract available: www.informaworld.com/smpp/content~content=a911741362&db=all]

Bennett and colleagues conduct two systematic reviews of research articles on small group discussions among secondary science students, published between 1980 and 2005. The reviews aim to characterize the ways small group discussions are used in classrooms and examine the effects of small group discussion on students’ learning. The authors note a dearth of research that aims to determine the effect of small group discussion on students’ interests and attitudes. The reviews reveal that the main goals for discussion were formative assessment (i.e., knowing what students know to inform instructional decisions) and development of students’ communication and argumentation skills. In table 3, the authors offer an annotated list of the research reports, including quality ratings, details about the participant sample, focus of the study, and nature of the data gathered. Within groups, the leader’s use of an inclusive discussion style was associated with student learning gains. Diversity of ideas within a group also correlated with enhanced learning, whereas gender diversity did not. The full technical reports are open access and available in Bennett *et al.* (2004a,b).

2. Lawson, A. E. (2009). How “scientific” is science education research? *J. Res. Sci. Teach.* Online first (no volume or page numbers available).

[Abstract available: www3.interscience.wiley.com/journal/123196760/abstract]

Lawson surveys articles from the *Journal of Research in Science Teaching* that spanned the journal’s history (i.e., 1965, 1975, 1985, 1995, and 2005) to determine their levels of scientific epistemology. Epistemological level 1 is defined as descriptive science, level 2 focuses on hypothesis formation and testing, and level 3 corresponds to science that is theory driven or has general explanatory frameworks that inform the development and testing of hypotheses. For example, a study describing goings-on in a classroom would be classified as level 1. A study testing whether an intervention enhances student learning would be level 2. A study attempting to determine whether students’ stage of cognitive development, as described by Piaget, could explain their difficulties understanding an abstract scientific concept would be level 3. Lawson categorizes articles from each publication year by using a computer-generated survey that identified articles containing the terms “hypothesis,” “prediction,” and “theory” and a subsequent manual review of articles published in 2005 alone. The computer survey revealed that the percentage of articles using the term “theory” had risen dramatically from 18% in 1965 to 87% in 2005. The percentage with the term “hypothesis” was relatively constant, fluctuating from a high of 54% in 1975 to a low of 32% in 1965. Even at its peak of 18% in 2005, the use of all three terms was low. The manual review exposed the limitations of the computer-survey approach because it revealed that some articles that did not use these terms involved some sort of theory or hypothesis testing. Lawson argues that authors must be more explicit in their descriptions of their research in order to make clear the hypotheses being tested as well as theories that relate to the work. He ends with a series of guiding questions to assist authors in doing so.

3. Lee, M.-H., Wu, Y.-T., and Tsai, C.-C. (2009). Research trends in science education from 2003 to 2007: a content analysis of publications in selected journals. *Int. J. Sci. Educ.* 31, 1999–2020.

[Abstract available: www.informaworld.com/smpp/content~db=all~content=a905023552]

In this review of more than 800 articles published in three high-profile science education journals between 2003 and 2007, Lee and colleagues identify a number of trends in the

DOI: 10.1187/cbe.09–12–0097

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study of science teaching and learning. They also compare these trends to those observed in publications between 1998 and 2002. Specifically, an increasing number of authors from countries other than the United States, the United Kingdom, Australia, and Canada are publishing in these journals. Studies are moving from a focus on student conceptual understanding to the factors that influence student learning such as the learning environment, reasoning, and affect. The authors also examine which papers were highly cited, identifying articles on argumentation and the nature of science as gaining the most attention in the field.

4. Minner, D. D., Levy, A. J., and Century, J. R. (2009). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984–2002. *J. Res. Sci. Teach.* Online first (no volume or page numbers available).

[Abstract available: www3.interscience.wiley.com/journal/123205106/abstract]

In this review of research spanning 1984–2002, Minner and colleagues aim to determine the impact of inquiry science instruction on K–12 student outcomes. The authors define four criteria for inquiry science instruction: focus on science content, student engagement with scientific phenomena, instruction via some element of investigation, and pedagogical practices that emphasized student responsibility for learning or active thinking. These criteria are used to select a set of studies that were then classified by types of student outcomes, such as understanding and retention, and research design (i.e., experimental, quasi-experimental, and nonexperimental). The authors also give each study a rating of methodological rigor based on clarity of the study (e.g., description of the sample and methods), quality of the data (e.g., attrition of participants and appropriateness of the instrument), and integrity of the analysis (e.g., systematicity of the analysis and bias in reporting findings). The most pervasive flaw in this body of research is the absence of clear methodological descriptions, which compromises interpretation of the results. Fifty-one percent of the studies show a positive impact on student learning or retention, 33% show mixed impact, and smaller percentages show negative or no impact. The authors use a series of regression models to examine the extent to which each of their criteria are related to positive student outcomes, for example, whether the amount of inquiry was a predictor of student learning. The most significant predictor of positive student outcomes was the extent to which students engaged in what the authors call “active thinking,” in other words, using logic, thinking creatively, making deductions, or building on prior knowledge.

5. Sadler, T. D., Burgin, S., McKinney, L., and Ponjuan, L. (2009). Learning science through research apprenticeships: a critical review of the literature. *J. Res. Sci. Teach.* Online first (no volume or page numbers available).

[Abstract available: www3.interscience.wiley.com/journal/122686762/abstract]

In this review of 53 studies, Sadler and colleagues identify outcomes associated with research apprenticeships for high school students, undergraduates, and preservice and inservice teachers. The authors summarize the body of literature and provide information about the apprenticeship duration, research design, and data collection methods for each study. Student apprentices show enhanced interest in or aspirations toward scientific careers, and student and teacher apprentices

improve their understanding of aspects of the nature of science. Few studies demonstrate increases in science content knowledge as a result of apprenticeship experiences. Small numbers of studies associate apprenticeship experiences with gains in confidence, intellectual development, and skill development. Absence of outcomes is typically associated with shorter duration apprenticeships (i.e., 2-week experiences). Sadler and colleagues make three recommendations based on their findings. First, research experiences should be extended over time. Second, these experiences should be supplemented with activities specifically designed to draw apprentices’ attention to desired learning outcomes. Finally, apprentices should be engaged in the higher-order practices of research, including analysis of data, generation of hypotheses, and development of research questions.

6. Wood, W. B. (2009). Innovations in teaching undergraduate biology and why we need them. *Annu. Rev. Cell Dev. Biol.* 25, 93–112.

[Full text available at: <http://arjournals.annualreviews.org/eprint/synFRFpX73gPUlkjFfa/full/10.1146/annurev.cellbio.24.110707.175306>; Posted with permission from the Annual Review of Cell and Development Biology, Vol. 25, © by Annual Reviews, www.annualreviews.org]

In this review, Wood describes the state of undergraduate biology education and highlights recent research from the fields of cognitive science, educational psychology, and discipline-based educational research that is now informing views of undergraduate teaching and learning. He summarizes promising practices in college teaching and draws attention to some of the evidence that supports these practices. His table 2 is particularly useful, as it offers a side-by-side comparison of traditional versus research-based practices for organizing course content, giving feedback to students, integrating teaching assistants into instruction, and other aspects of course design and implementation. Instructors can use these concrete examples to visualize ways to reform their own teaching practices. Wood ends by describing how good teaching is of particular importance in introductory biology courses, which not only lay the foundation for more advanced course work for life science majors, but also enroll many students who will not be biologists.

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).

REFERENCES

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