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. *Current Insights* typically alternates between highlighting a variety of current literature and featuring a group of articles on a particular theme. This themed issue focuses on recent research on the teaching and learning of evolution, including lessons learned from K–12, undergraduate, and medical education.

1. Catley, K., Lehrer, R., and Reiser, B. (2005). Tracing a prospective learning progression for developing understanding of evolution. Paper commissioned by the National Academies Committee on Test Design for K–12 Science Achievement.

[Open access: www7.nationalacademies.org/bota/Evolution.pdf].

Catley and colleagues outline pathways for learning about evolution across grade levels. The authors start by defining the “big ideas” related to evolutionary theory, including mathematical tools (e.g., measurement and distribution) and forms of argument (e.g., model-based reasoning, comparative methods of science, and historic interpretation and reconstruction). Then, they review the literature regarding student understanding of these ideas, such as understanding of the mechanisms of natural selection and random variation and comprehension of geologic time. The authors delve into the particularities of each challenge, for example, that students may be able to define natural selection but may not be able to consider how mutations act within a population. The authors chart the development of core concepts and learning performances for grades K–2 (primary), 3–5 (elementary), and 6–8 (middle). For example, with respect to the idea of diversity, primary students have the capacity to consider similarities and differences among organisms, elementary students are capable of characterizing organisms and classifying them accordingly, and middle school students can begin to consider diversity as a result of change, variation,

and ecology. The authors also offer sample classroom investigations, cite URLs for other resources (e.g., teacher lesson plans and descriptions of student thinking), and point to gaps or contradictions in the literature as future directions for research.

2. Donnelly, L. A., Kazempour, M., and Amirshokoohi, A. (2008). High school students’ perceptions of evolution instruction: acceptance and evolution learning experiences. *Res. Sci. Educ.*

[Online first, no volume or page numbers available; Abstract available: www.springerlink.com/content/r7410k51534n6011].

Donnelly and colleagues use a mixed methods approach to explore high school students’ acceptance or rejection of evolution and their views of evolution teaching and learning. Thirty-three general and advanced placement biology students from a rural county in a conservative midwestern state participated in the study. Data regarding students’ acceptance of evolution were documented using a Likert-type instrument called the Measure of Acceptance of the Theory of Evolution. Students were interviewed about their evolution learning experiences and completed a second Likert-type survey about their views of evolution teaching methods and their enjoyment of learning evolution. The authors analyzed the students’ responses by using a “border crossing” perspective, through which they explored how the students’ home and school cultures may differ and how students navigate these differences. The idea of human evolution prompted the most significant border clash, triggering greater concern and doubt for students than animal or plant evolution, microevolution, or natural selection. Regardless, students who were acceptors and rejectors of evolution believed that evolution should be taught. Students negotiated border crossing, especially in coming to understand human evolution, by 1) believing that understanding evolution does not require accepting it (i.e., there is no personal risk involved in crossing the border), 2) viewing evolution as one of many possible perspectives (i.e., it does not hurt to cross the border), or 3) viewing evolution as important to learn because it has high scientific status and it is good to understand the perspectives of others (i.e., there is a reason to cross the border).

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3. Downie, J. R. (2004). Evolution in health and disease: the role of evolutionary biology in the medical curriculum. *Biosci. Educ.* 4, 4-3.

[Open access: www.bioscience.heacademy.ac.uk/journal/vol4/Beej-4-3.aspx].

Downie takes a three-pronged approach to studying evolution education in medical schools in the United Kingdom. First, the author surveyed course directors about undergraduate medical curricula, <40% of which included evolution instruction. Second, the author surveyed first-year medical students to identify the proportion who were acceptors versus rejectors of evolution. Approximately 10% of respondents rejected evolutionary theory because of conflicts with their religious beliefs rather than concerns about lack of evidence or contradictory evidence about evolution. More than half of the evolution acceptors also identified with a particular faith (e.g., Christianity, Catholicism, Islam, or Judaism); thus, faith identity did not by itself preclude acceptance of evolutionary theory. In addition, evolution acceptors also saw it as relevant to understanding medicine. Finally, Downie surveyed third-year medical students who participated in a 5-wk special study module titled Evolution in Health and Disease. Students who completed this module rated evolution as more relevant to medicine than the general population of first-year students. Because the third-year students were a self-selecting group (i.e., only 10% of the third-year class participated in the module), they may have chosen to enroll in the module because they saw evolution as particularly relevant to medicine. Alternatively, the explicit teaching about health and disease from an evolutionary perspective may have laid the groundwork for students to see the medical relevance of evolution.

4. Goldston, M. J., and Kyzer, P. (2009). Teaching evolution: narratives with a view from three southern biology teachers in the USA. *J. Res. Sci. Teach.*

[Online first, no volume or page numbers available; Abstract available: www3.interscience.wiley.com/journal/122267977/abstract].

Goldston and Kyzer take an ethnographic approach to developing case studies of three biology teachers in the southern U.S. By observing these teachers throughout the academic year and collecting interview data from the teachers and their students, the authors are able to develop comprehensive pictures of how the teachers typically approach instruction and whether their approaches change as they teach about evolution. The teachers in this study gave the textbook greater authority, spent less time on the topic, and prompted less student discussion when teaching about evolution versus other concepts in biology. The teachers struggled to balance the value of teaching about evolution with their perceptions of the sociocultural tensions that resulted from evolution instruction. The vagueness of state standards regarding the relevance of evolutionary theory to biology learning left decision-making about whether and how to teach evolution to individual teachers. The authors note that teacher autonomy is an essential element of the profession but can be a liability in evolution education. In addition, the findings from this study highlight the importance of addressing sociocultural issues, not just

knowledge about evolutionary theory, in preparing teachers to teach about evolution.

5. Lombrozo, T., Thanukos, A., and Weisberg, M. (2008). The importance of understanding the nature of science for accepting evolution. *Evol. Educ. Outreach* 1, 290-298.

[Open access: www.springerlink.com/content/f82518w0p8531512].

Lombrozo and colleagues explored how students' knowledge about the nature of science correlates with their acceptance of evolutionary theory. The authors generated a 60-item Likert-type survey based on the Student Understanding of Science and Scientific Inquiry instrument (Liang *et al.*, 2006) to document undergraduate students' views of the nature of science (NOS), attitudes toward science, acceptance of evolution, and religiosity. It is not clear whether any validity or reliability studies were conducted with the adapted instrument before its use in this study. The authors identified a moderate and significant correlation between students' acceptance of evolution and their NOS score, even when controlling for their previous science education and attitudes toward science. The authors use factor analysis to identify three components of students' NOS scores: 1) complexity of science, 2) meaning of theories, and 3) sociocultural context in which science is done. Evolution acceptors were more likely to have high scores related to complexity (e.g., science is nonlinear and has many sources of evidence) and theories (e.g., scientific theories are based on an abundance of evidence but are not ever "provable").

6. Nehm, R. H., and Schonfeld, I. S. (2008). Measuring knowledge of natural selection: a comparison of the CINS, an open-response instrument, and an oral interview. *J. Res. Sci. Teach.* 45, 1131-1160.

[Abstract available: www3.interscience.wiley.com/journal/119031195/abstract].

Nehm and Schonfeld conducted a comparative study of three instruments for measuring students' understanding of natural selection: conceptual inventory of natural selection (CINS; Anderson *et al.*, 2002), open response instrument (ORI; adapted from Bishop and Anderson, 1990), and oral interview. Undergraduates in second-semester introductory biology courses participated in the study by completing all three instruments ($n = 18$), CINS and ORI ($n = 82$), or ORI alone ($n = 82$). ORI comprises five open-ended essay questions designed to measure the range of students' thinking about natural selection, from simple factual knowledge to more complex synthesis. CINS is a 20-item multiple-choice instrument that includes a series of distractors based on well-documented alternative conceptions (e.g., an item has one correct answer plus one or more incorrect answers based on misconceptions about natural selection). The oral interview questions were based on items from the CINS and ORI. The authors compared students' responses to the three instruments to determine "convergence validity," in other words, that they are measuring the same construct: student understanding of natural selection. Indeed, CINS, ORI, and interview results were similar with respect to students' understanding of key concepts of natural selection (e.g., diversity, limited survival). The ORI and interview yielded similar results regarding students' alterna-

tive conceptions, whereas the CINS was not useful for this purpose. The authors propose that the CINS be used as a less labor-intensive method for measuring students' knowledge about key concepts of natural selection and that the ORI be used for documenting students' alternative conceptions.

RESOURCES FOR EDUCATION RESEARCH AND PRACTICE

Bioscience Education [www.bioscience.heacademy.ac.uk/journal/index.aspx].

Bioscience Education is an online, open-access journal owned and published by the United Kingdom Centre for Bioscience, which aims to support higher education in the life sciences. The journal is primarily written for and by life scientists to promote, enhance, and disseminate research, good practice, and innovation in teaching and learning at the tertiary level. *Bioscience Education* features several types of articles, including research papers, essays, and short communications.

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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