Science in Solution [Review of the book Science in Solution: The impact of undergraduate research on student learning, by D. Lopatto]

Krishna Bista

Reviewed by Krishna Bista, Center for Excellence in Education, Arkansas State University (USA), krishna.bista@gmail.com

Undergraduate research in American higher education is one of the fastest growing phenomena among scholars. In this context, David Lopatto’s book *Science in Solution: The Impact of Undergraduate Research on Student Learning* (2010) is an important resource in undergraduate research literature for students, faculty, and researchers in the field. Lopatto offers research-based evidence of personal and professional value of undergraduate research, and he explains ways in which he has engaged his students in scientific activities.

The book is organized into seven chapters, each chapter entwining elements and themes of undergraduate research in a linear consequence with past literature, research frameworks, and results of current research. Each chapter includes data and findings from the Summer Undergraduate Research Experience survey that the author administered to more than 10,000 student participants from 150 American colleges and universities. He also presents several illustrations of research findings that come from his 2003 summer undergraduate research and teaching.

Chapter 1 deals with the historical context of undergraduate research from the early 1990s to 2010 in American colleges and universities. Lopatto lists a number of restraining forces in undergraduate science research such as elite groups of society controlling mass education, shortage of scientists in research, scientific surplus, and emphasis on teaching instead of research. The author also examines a shift in the undergraduate research paradigm in which educators now acknowledge the value of conducting cutting-edge research in their institutions. In this book, Lopatto mentions that “an undergraduate research experience contains the potential for a rich and multifaceted interaction between student scholar and faculty mentor” (p. 8). Along with the establishments of the Council on Undergraduate Research (CUR) and the National Conference on Undergraduate Research (NCUR), the author sees a shift in the traditional dichotomy between the professional roles of teaching and
research not only in the Science, Technology, Engineering and Mathematics (STEM) workforce but also in other disciplines.

Chapter 2 outlines the essential features of undergraduate research such as student input, faculty-student interactions, and working with groups toward “student development and knowledge production” (p. 15). As a part of research, the author expects students to read scientific literature, work independently with faculty, participate in oral and written communication, and so forth. This chapter also includes illustrations (tables) to support those essential features of an undergraduate research project from the author’s previous research conducted in 2003.

Chapter 3 describes both personal and professional benefits of undergraduate research. Lopatto mentions that personal benefits include increased self-confidence, independence, readiness for the next level of challenge, and ability to tolerate obstacles. Professional benefits include scientific skills such as critical-thinking, communications, and making presentations among other students and faculty members. At the end of the chapter, Lopatto provides an illustration of how his previous research indicates how conducting undergraduate research benefits students.

Chapter 4 explores how undergraduate research benefits students in personal growth and specific skills across disciplines. Lopatto describes three aspects of undergraduate research. First, he suggests the standard science curriculum in which students perform lab work, course work, or work on a project independently. Second, through interdisciplinary education and research, Lopatto believes that students would “recognize the world problems — climate change, emerging pathogens, energy production — have obvious connections to discipline in the social sciences and humanities” (p. 55). Third, research with underrepresented ethnic and gender groups may benefit students by identifying interactions and relationships in social behaviors and attitudes.

Chapter 5 defines mentoring in the context of undergraduate research and explains how mentoring fosters student-faculty relations for student development — “the development of competence, sense of purpose, and autonomy” (p. 63). Lopatto explains the significance of mentoring, student age and mentorship, and mentoring and leadership. Since a mentor has leadership power to grade or to provide a letter of reference for the undergraduate student, Lopatto suggests to his fellow mentors at colleges and universities that they be “a role model for leadership” (p.71) when working with students. Lopatto also presents illustrations of qualitative and quantitative data from his previous research where students evaluated their mentor traits as “friendly,” “respectful,” and “as a colleague.”
Chapter 6 compares and contrasts salient features of teaching and research in higher education. The author explains research as public knowledge, the systematic outcome of a study, and a required part of higher education. For him, scientific teaching includes “both modeling the process of science and using data to learn about student learning” (p. 81). This teaching is not about finding the “one best way” to teach science at colleges and universities.

Chapter 7 describes undergraduate research as a form of institutional transformation in which the author compares research students to “buzzing electrons down the windowed corridors of the science building” (p. 85). He believes that undergraduate research students bridge a gap between traditional and modern learning systems, facilitate change, and support faculty tenure requirements through research activities. Lopatto also believes that research-centered undergraduate science curricula bring changes to the roles of students and faculty members, creating “new networks of collaborators” (p. 89) in education.

Overall, Science in Solution offers fresh perspectives about how undergraduate students can actively participate in research activities and provide a bridge between the two poles of publication and teaching. In addition, it shows an increased commitment to undergraduate science research in American communities of learners. One of the strengths of this book is to let educators contemplate the effectiveness of undergraduate science research, as well as the value of teaching students to maximize their hidden research potential early in their academic careers.

**Works Cited**
