

Guest Editorial

A Passion for Science Education Reform and the Role of Undergraduate Research

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Undergraduate research is a concept much talked about in the communities of individuals and institutions concerned about the quality of the learning environment within the nation's colleges and universities. From the character of some of these conversations, one might assume that undergraduate research is similar to *motherhood* and *apple pie*, an abstract notion of something worth while, but one that does not demand serious consideration of how this abstraction can be translated into programs that affect today's students and teachers.

In the context of an inaugural issue of an international refereed journal on undergraduate research in science, mathematics, engineering and technology (STEM), I challenge the editors and readers to take a leadership role in clarifying this concept, to speak from their own experience and expertise about how engagement in undergraduate research serves students, science, and—ultimately—society.

I speak from the vantage point of my work with Project Kaleidoscope (PKAL), an informal alliance taking a leadership role in the work of strengthening the learning of undergraduates in STEM fields. This focus on students is the crux of the matter for those of us involved with PKAL. Our attention to faculty, curriculum and facilities, as well as to institutional issues, is driven by a consideration of how policies, programs and practices affect the character of learning for students. What role does undergraduate research have in preparing students for a world increasing dominated by science and technology? My proposition is that the experiences of students involved in research

are the most meaningful educational experiences for those who will live and work in the 21st century. Let me explain.

“What the world needs now...” is a popular song that sets the stage for my explanation. What the world needs now are leaders who know how to ask “What if...?” Or “What next?”—people who are passionate about exploring and investigating and discovering new ways of making sense of and shaping the world in which we live. In considering the undergraduate learning environment, we must be mindful that one can only look beyond the edges of the field from a solid grounding in the field, thus it is helpful to consider various definitions of research (here taken from my trusty Webster's):

- ...to investigate thoroughly, to search;
- ...careful or diligent search, studious inquiry or examination;
- ...the collecting of information about a particular subject;

- ...the investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws.

Someone called scientists the scouts and hunters of our society, the people who keep pushing the edge because they are not satisfied with the status quo. In his *Adventures of Ideas*, written in 1933, Alfred North Whitehead describes a world that today “...is passing into a new stage of its existence. New knowledge and new technologies have altered the proportions of things. How much more today do we need

people experienced in pursuing the unknown?"

Being involved in research as an undergraduate challenges students to be able and willing to move beyond their comfort zone into what Whitehead would call adventures beyond the safeties of the past as they explore, experiment, and create new knowledge. But these experiences also give students other skills and capacities.

For one, students learn to take responsibility for what they are learning; figuring out how to define and solve problems, and determining how to use technologies to gather, assess and present data. Students gain another important lesson as they 'do' science— how to cope with the failures that are certain to occur. They also begin to learn to collaborate, working in teams with people with different backgrounds and perspectives. The experience of the scientific community—a community of collaborators—is that creativity is sparked when diverse groups of people work together in asking the what if and why not questions. Different interpretations and answers lead to new possibilities that an individual working alone might not have arrived at.

Students involved in undergraduate research also learn how to communicate to others the results of their explorations, in written or spoken form. Scientists are storytellers because they wish to share their adventures with colleagues; they become compelling storytellers when they are passionate about what they are doing.

What the world needs now... are people who can make a difference because they have particular skills and understandings, capacities and passions that come from a rigorous engagement with research during their undergraduate years.

What I hope for this new journal is that it pushes the edge for all of us, taking us into new adventures about the power of learning through undergraduate research. My hope is that your voice becomes a persistent reminder for the larger community that it is what happens to the students that really matters.

Jeanne L. Narum is founder and Director of Project Kaleidoscope (PKAL), an informal national alliance of individuals, institutions, and organizations committed to strengthening undergraduate science, technology, engineering, and mathematics education. More information about PKAL, its people and programs, can be found on its website at <http://www.pkal.org>.

