Foreword

In *Cases on Interdisciplinary Research Trends in Science, Technology, Engineering, and Mathematics: Studies on Urban Classrooms,* Reneta Lansiquot has compiled exemplars of innovative and inspiring curricular reforms that engage and retain underrepresented students in successful studies of the sciences from a broad set of institutions. In this set of cases, it was the explicit voice of the student that I found most compelling in Marlene Hidalgo's "Interdisciplinary Learning from a Student's Perspective." It was strong evidence of the power of an interdisciplinary learning experience for students today. Even at the point of enrolling in a class at New York City College of Technology (City Tech), needing only to complete a certificate, "Weird Science: Interpreting and Redefining Humanity," directly related to her career aspirations, she "was primarily drawn to its provocative theme." By the end of the course, she reflects that, "Actively participating in the creation of virtual content contributed to my understanding of what it means to be a virtual human in ways that lectures and journal articles could not. My experience in the group project emphasized the role of technology in the classroom, but also in a broader sense, and as it pertained to the theme of the course, to the human identity. While the process made it evident that humans are designers and makers, it was also clear that we are communicators."

Her end-of-course reflections caused me to pull from my files the many resources that inspired and informed the development of a proposal in 2007 from Project Kaleidoscope (PKAL) to the W. M. Keck Foundation. The primary case we made was adapted from *Facilitating Interdisciplinary Research*, that in preparing today's undergraduates on our campuses to be tomorrow's leaders in society, they must have opportunities for coming to understand how the need to address the social problems of tomorrow can best be done via an interdisciplinary application of technology and a respect for complexity.

The design of the Keck/PKAL initiative (2008–2011) was to engage faculty and administrators on a select number of campuses in exploring and experimenting with learning opportunities that would be beyond the scope of a single discipline, opportunities that were timely in their institutional context and reflected broader

societal problems and opportunities. The announced goal of this initiative was to understand what works as campus leaders take on the exploring and experimenting in the reshaping of curricular programs and the organizational infrastructures needed to support them. In reading Hidalgo's essay, however, I was reminded of the vision of this particular PKAL initiative and how it was grounded in the vision of a student-centered learning environment that has driven PKAL since its beginning in 1989. It is a vision about learners and learning environments, that *what works* is when:

Learning is personally meaningful to students and faculty, makes connections to other fields of inquiry, is embedded in the context of its own history and rationale, and suggests practical applications related to the experience of students (Project Kaleidoscope,1991).

That prescient *what works* vision was becoming even more relevant in the context of preparing the facilitating interdisciplinary learning proposal submitted to the W.M. Keck Foundation. Boundaries between disciplines were dissolving; new disciplines were emerging, societal problems becoming more urgent. It was also becoming clear that undergraduate students have shown themselves to be responsive to inter-disciplinary and problem-driven questions, especially those of societal relevance (National Academies, 2004). Further evidence of the relevance of that vision and the goals for the Keck/PKAL initiative comes from associations of national leaders, such as the Council on Competitiveness, which call on today's educational leaders to ensure students gain the capacities for creative thinking, for thriving in a col-laborative culture and working in diverse multi-disciplinary teams, for dealing with ambiguity, and for translating challenges in opportunities and understanding how to complete solutions from a range of range of resources (Project Kaleidoscope, 2006).

It is clear from Hidalgo's case that Weird Science is one example of the kind of curricular initiative that met such learning outcomes, even despite, as she notes, "the variability and unpredictability of the individual experience." At the beginning and throughout the Keck/PKAL initiative, we wrestled with learning goals for today's undergraduates that would be more descriptive of the current reality while remain-ing grounded in the historical mission of higher education in our country. As noted by Bruce Keith, in his chapter entitled "Energizing Interdisciplinarity: Addressing Army Energy through Curricular Reform at West Point," today's college graduates must be increasingly "comfortable with ambiguity and capable of critical, creative, and analytical thinking. [They must be] agile and adept problem-solvers who can reflect on and responsibly consider the social consequences of their actions," which captures the essence of the goals driving those involved in this initiative.

In an early meeting of Keck/PKAL institutional teams, we were introduced to the mental image of a "boundary-crossing agent." For me, this was a different way to

describe what students would be able to know, what they would be becoming from their experience with an integrative/interdisciplinary learning experience. Hidalgo's journey between real and virtual worlds, between worlds of the natural and social sciences, technology, and engineering, and in finding new ways for collaborating and sharing knowledge, qualifies her as a boundary-crossing agent, even though there may not yet be a City Tech certificate that would make that formal.

However, on reflecting on the broader Keck/PKAL initiative and on the cases presented here, there is strong evidence that if students are to become boundary-crossing agents, campus leaders must become visible models of what a boundary-crossing agent is, of how to collaborate and share knowledge in the process of tackling a problem that really matters to the community and for which the solution is beyond the scope of any single discipline or sphere of responsibility. Ultimately, boundary-crossing agents create something new, something that makes the experiences of those within a community more relevant and meaningful. Thus, what was learned about the experiences of students in interdisciplinary and integrative learning opportunities can be seen also as *what works* when a campus seeks to ensure their undergraduate students are becoming boundary-crossing agents, by giving them substantive opportunities to understand how the need to address the social problems of tomorrow can best be done via an interdisciplinary application of technology and a respect for complexity.

The final report of the Keck/PKAL Facilitating Interdisciplinary Learning project, edited by Susan Elrod, now Executive Director of PKAL, and Mary Roth, Associate Provost at Lafayette College, presents these as the common learning outcomes as defined by participating institutions (Project Kaleidoscope, 2011). Undergraduate students (institutional teams) will be able to:

- Recognize disciplinary strengths, process, limitations, and perspectives.
- Purposefully connect and integrate knowledge and skills from across disciplines to solve problems.
- Synthesize and transfer knowledge across disciplinary boundaries, even beyond the STEM disciplines, in the context of novel situations.
- Be agile, flexible, reflective thinkers who are comfortable with complexity and uncertainty, and can apply their knowledge to respond appropriately and positively.
- Understand that other factors—cultural, political, ethical, historical, and economic—must be considered when addressing the complex problems of this century.
- Understand the universal nature and deep structure of science, as well as the relationship of STEM disciplines to other disciplines.
- Prepare for future learning as lifelong learners in their careers and as citizens.

- Apply their capacity as integrative thinkers to solve problems in ethically and socially responsible ways.
- Think critically, communicate effectively, and work collaboratively with others within diverse cultures and communities.

What we learned throughout this Keck/PKAL initiative and what is clearly illustrated in the set of cases that Lansiquot has highlighted in this publication is that *what works* is when institutional leadership teams have these same characteristics and ways of thinking and doing across boundaries.

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