

Universities have a natural tendency to relegate each problem to the province of one or another academic discipline or profession. But the most challenging problems cannot be addressed by one discipline or profession. We cannot understand the AIDS epidemic, for example, without joining the perspectives of medicine, nursing, and finance with those of biochemistry, psychology, sociology, politics, history, and literature.

—President Amy Gutmann, inaugural address, 2004

Chapter 5: Integrating Knowledge

Introduction

With twelve diverse and outstanding schools on one contiguous campus, Penn is uniquely positioned to be a global leader in integrating knowledge across disciplines. Since the Penn Compact formalized this priority in 2004, it has become an increasingly defining element of teaching and learning at Penn. Our undergraduates take advantage of a wide range of minors, dual majors, and interdisciplinary programs. Our faculty and research have been enriched by an increased focus on interdisciplinary hiring exemplified by the Penn Integrates Knowledge Professors program, which brings highly distinguished senior professors to campus with appointments across two different schools.

This spirit of cooperation, collaboration, and community reflects Benjamin Franklin’s view of the revolution, “We must all hang together, or assuredly we shall all hang separately.” Bringing ideas, minds, and passion into the same arena is how Penn integrates knowledge. From interschool efforts in neuroscience, behavior, ethics, materials, and communication to cross-cutting combined majors, from broadly constructed graduate groups to a diverse student body and faculty, this emphasis has made Penn a preeminent locus for integrating knowledge, which we view as the essential spark to ignite intellectual and creative innovation.

Much of the obvious benefit of integrating knowledge occurs in research, as disciplines combine to solve problems or ask new questions, and graduate students are trained in methods and areas of knowledge that cross disciplinary boundaries. Undergraduates benefit from this research activity indirectly when their teachers bring new ideas and methods to the classroom, and yet the benefits for undergraduate education extend beyond research and instruction. Encounters across disciplinary lines help students and faculty alike become aware of the boundaries that separate bodies of disciplinary knowledge and identify which additional bodies of knowledge scholars need to acquire to transcend those boundaries and produce strong, rigorous innovation. In short, integrating knowledge is at the core of Penn’s identity as a research university and as a site of undergraduate education.

Working Group Charge and Process

The charge to the Integrating Knowledge Working Group was to evaluate Penn’s efforts at integrating knowledge, especially as those efforts relate to undergraduate education. The group was asked to articulate what is important about Penn’s current efforts at integrating knowledge and how those

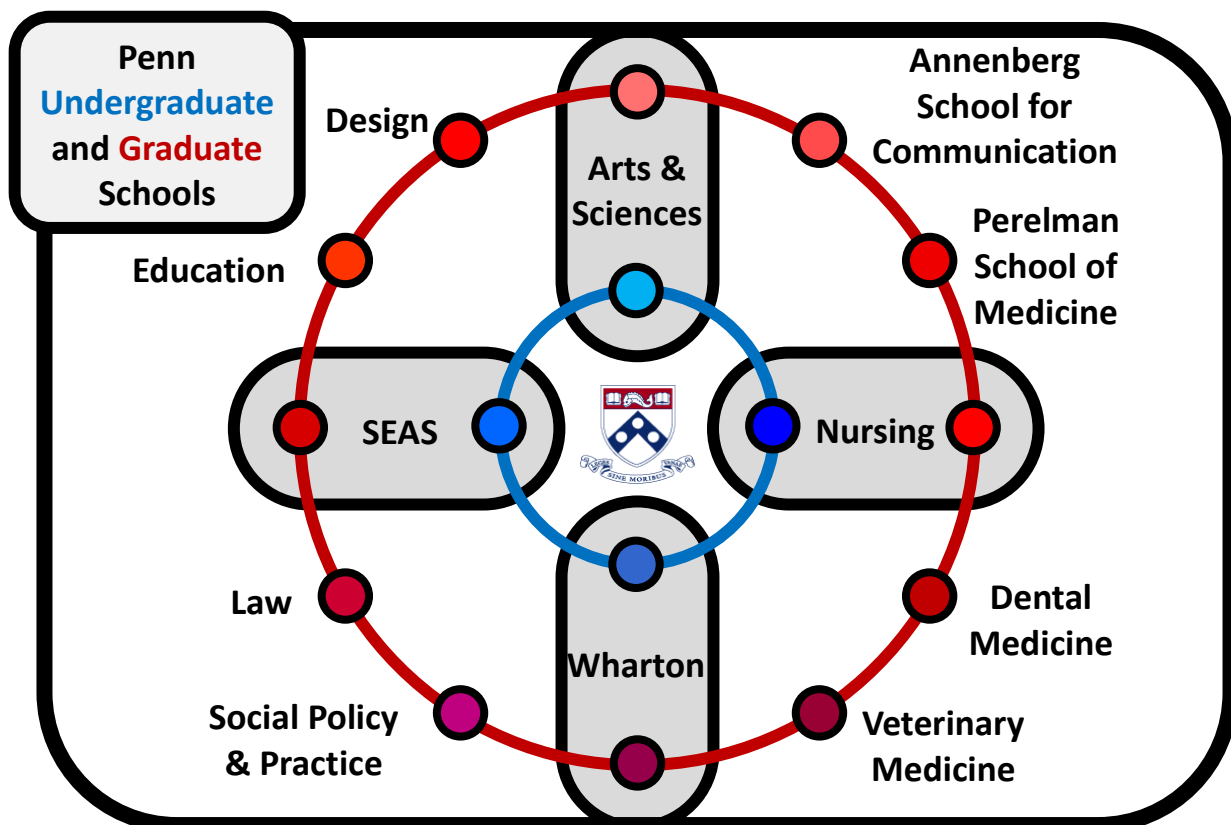
efforts could be improved, within the framework of the MSCHE Standards of Excellence, especially Standards 7, 11, and 14. Specific tasks included:

- Provide a cohesive definition of Penn’s conception of integrating knowledge;
- Collate prior and current activities that exemplify Penn’s implementation of the ideals of integrating knowledge in the context of undergraduate education;
- Consider the extent to which integrating knowledge is occurring and contemplate how Penn’s efforts in this area may be effectively assessed;
- Ascertain how strategic considerations—from planned investments to the role of technology — will impact Penn’s implementation of integrating knowledge in the undergraduate curriculum;
- Provide recommendations regarding the strategic direction for Penn’s efforts at integrating knowledge over the next decade.

Overview and definition

Penn consists of a dozen schools (Figure 5.1). While only four of them are undergraduate schools, all of them work together to advance Penn’s missions of teaching, research, engagement, and integration. The geometry of Penn—a compact, urban campus, keeping all schools proximate—not only admits but also prescribes discourse and cooperation among the disciplines.

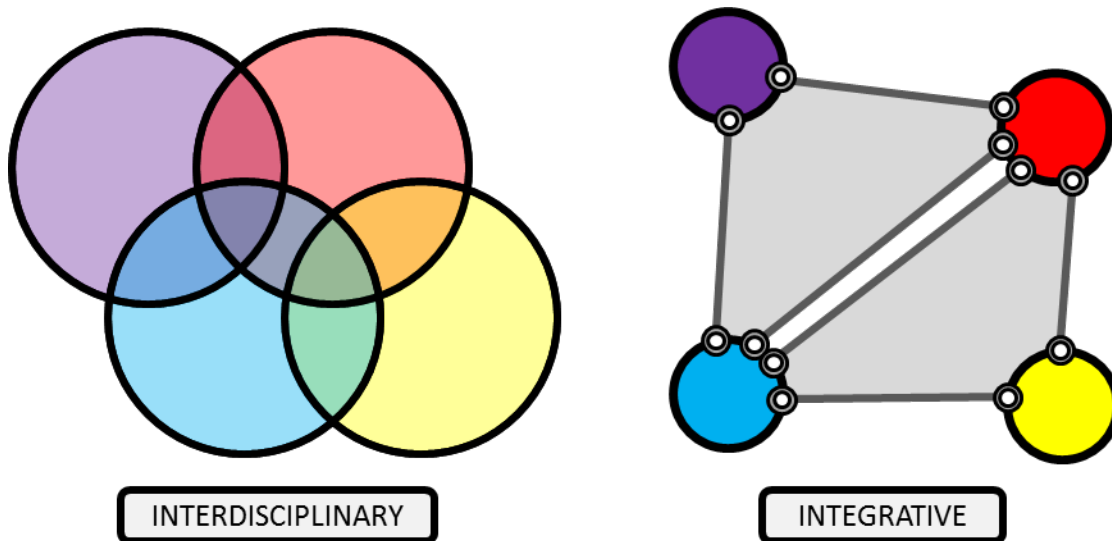
Figure 5.1
Penn Undergraduate and Graduate Schools



The idea that we should integrate knowledge is one of those obviously good things, like *critical thinking* or *abstract reasoning*. It is hard to find any discontent with the goal, but it is equally difficult to find a robust definition. For the last half-century, the idea of *interdisciplinarity* has been the most typical mode by which integrative thinking has been articulated. The idea was that by knocking down walls we would allow knowledge to cross-fertilize and flourish. But in recent years, the value of the disciplines has also re-emerged. The disciplines are useful because they discipline us. They demand that claims to knowledge submit to rigorous scrutiny and, in so doing, make more valuable the proposals that succeed.

The substance of Penn's notion of integrating knowledge is less one of *interdisciplinarity* than of *multidisciplinarity*, in which students and faculty from distinct disciplines communicate and progress not by flattening of walls, but by becoming more nimble at scaling them and so developing their familiarity with other territories (Figure 5.2). Interdisciplinarity suggests intersection or overlap. Multidisciplinarity carries the connotation of link and connection.

Figure 5.2
Interdisciplinary Vs. Integrative



Penn embodies the notion of the university as a network of distinct disciplines, connected via discourse, research, and engagement. Good fences make good neighbors; cell walls permit multicellular complexity; integrating distinct disciplines yields a comprehensive corpus of engagement with the world, sparking synthesis and innovation.

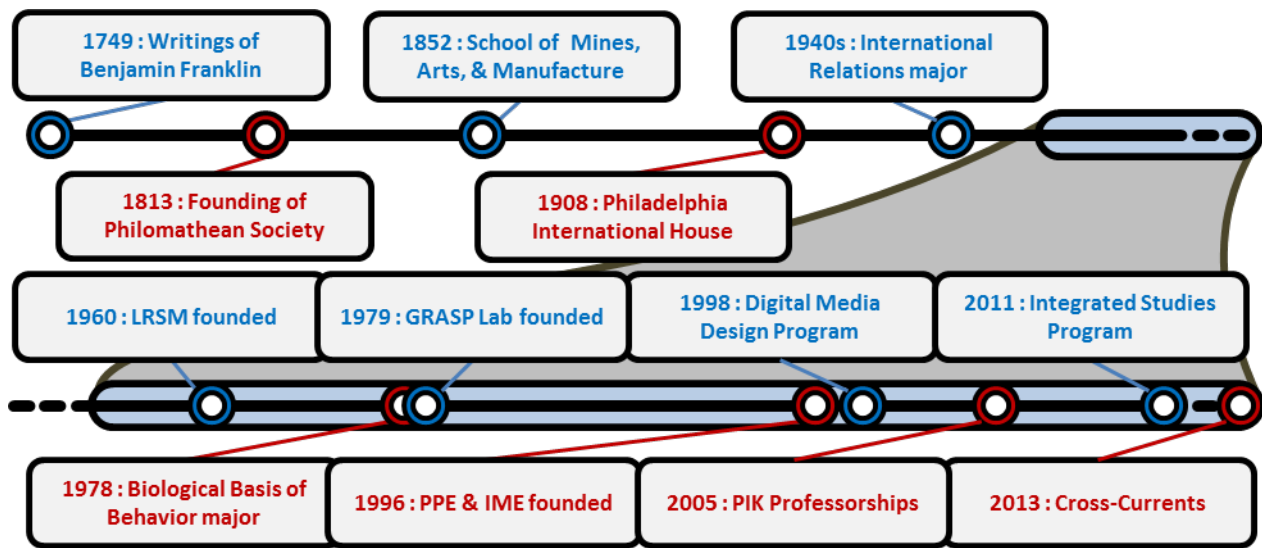
The locus of integrating knowledge is not limited to interdisciplinary centers, multidisciplinary courses, and cross-school initiatives. Though these are all important coincident markers of integration, Penn's

definition of integrating knowledge—the process of actively connecting and fusing distinct disciplinary ideas—encompasses these and more, and it occurs whenever diverse ideas are engaged through teaching, learning, and research.

Timeline and History

Throughout Penn’s long history, the proximity and collaboration of different schools have been the basis of the integration of knowledge (Figure 5.3). Perhaps the first major offered at Penn that embodied the integration of knowledge was International Relations in the 1940s. The Biological

Figure 5.3
Timeline: Integrating Knowledge at Penn



Basis of Behavior (BBB) major, introduced in 1978, combined studies in neuroscience, psychology, and biology. The Philosophy, Politics, and Economics (PPE) major was developed in 1996 as it became clear to students and faculty that these three branches of knowledge can and should be integrated in order to address the needs of the world's societies, infrastructure, and cultures. The Digital Media Design program was created in 1998 as a full-fledged Bachelors in Engineering and Science (BSE) degree that combines major coursework in computer graphics in the Computer and Information Science Department, communication courses in the Annenberg School, and fine arts courses in the School of Design. In 2012, the Office of the Provost and the Council of Undergraduate Deans created Cross Currents, a program designed to promote interschool teaching. Cross Currents courses will be designed and taught by faculty members from at least two undergraduate schools, although participation by faculty in graduate and professional schools will be encouraged under the sponsorship of an undergraduate school. These courses will spotlight diverse intellectual perspectives across the University and their applications to vital social and cultural issues.

The past decade has also seen two important new interdisciplinary programs in the College of Arts and Sciences. The Visual Studies major was created in 2003 to allow students to engage a multidisciplinary course of study connecting the theory, practice, and culture of seeing across such diverse disciplines as art history, cinema studies, cognitive science, communication, neuroscience, philosophy, and psychology. In 2011, the Interdisciplinary Studies Program was created to allow students to consider the deepest and oldest of questions from an intrinsically broad perspective with the help of faculty from the humanities, social sciences, and natural sciences. More examples of integrative curricular programs are detailed in Appendix 5.1: Chart of Programs.

Benefits

The clear benefits of discipline-based learning are access to deep and specialized knowledge, as well as systematic ways of learning about a given field—methods that have been identified by recognized specialists as optimal for pursuing questions within a distinct realm. The disadvantage is the danger of stagnation, parochialism, over-specialization, and insularity. By actively pursuing conversations across disciplines, Penn works against these tendencies in undergraduate teaching, and, as a result, faculty become more aware of problematic tendencies in their own areas, such as foreclosed questions or methodological decisions that are made out of habit, rather than being intellectually motivated.

Encounters across disciplinary lines help students and faculty alike to become aware of the boundaries that separate bodies of disciplinary knowledge and to identify what specific additional bodies of knowledge scholars in all relevant disciplines need to acquire in order to be able to leap across those boundaries in a way that produces strong, innovative and rigorous research rather than a weak *interdisciplinarity*. The identification of these interstitial knowledge bases may require the development of new research methods, questions, and practices, thereby fostering innovative and creative undergraduate and faculty research projects. This kind of intellectual flexibility models for students a willingness to develop research methods in response to unknown and under-explored areas of knowledge and encourages critical reflection on our existing structures for the transmission and expansion of knowledge.

Many integrated knowledge courses at Penn have roots in faculty research projects in which faculty members collaborated with scholars beyond their disciplinary base. Consequently, integrated knowledge courses can offer a model of Humboldt's ideal vision of the research university, in which teaching and research feed each other and cross-generational exchange keeps knowledge a dynamic rather than a leaden thing.

Co-teaching can be an especially useful mode of integrating knowledge in the classroom. Collaborative teaching practices tend to lead to greater conversation and self-reflexivity about pedagogical methods, course structures, and teaching styles. Furthermore, a professor can become aware of pedagogical tools and classroom exercises common to another discipline but foreign to one's own, thus increasing the range of tools available to individual disciplines. Because co-teaching creates a regular forum for peer review and critical feedback about teaching, it is healthy for the standards of undergraduate and graduate education alike.

Assessing Student Participation

In Penn's vision of integrating knowledge, integration does not occur *within the degree program*, but rather *within the student*. Nevertheless, the degree to which integration of knowledge does occur in Penn's undergraduate experience is correlative with the number and types of explicitly integrative programs offered (and sought). The opportunities for integrating knowledge abound; one marker for the extent to which integrating knowledge occurs is the participation in specialized multidisciplinary and dual-degree programs.

Enrollment in specialized multidisciplinary and dual-degree programs at Penn is relatively small in relation to the entire undergraduate population; collectively, it accounts for a steady 10 percent of students in the past five years. Beyond these formal integrated majors, however, Penn students pursue multiple bachelor's degrees at a significant rate. Students who earn two or more bachelor's degrees (that is, a degree from two or more schools) comprise over 8.3 percent of the undergraduate body. Roughly one Penn undergraduate student in 10 is enrolled in an integrated, cross-school program of study. An additional one student in 11 is taking a self-constructed multiple-degree major. See Appendix 5.1: Chart of Integrating Knowledge Programs, for a complete overview of multiple degrees and cross-school programs.

Figure 5.4
 Distribution of Cross-School Dual Degrees by Primary Degree School 1998-2008

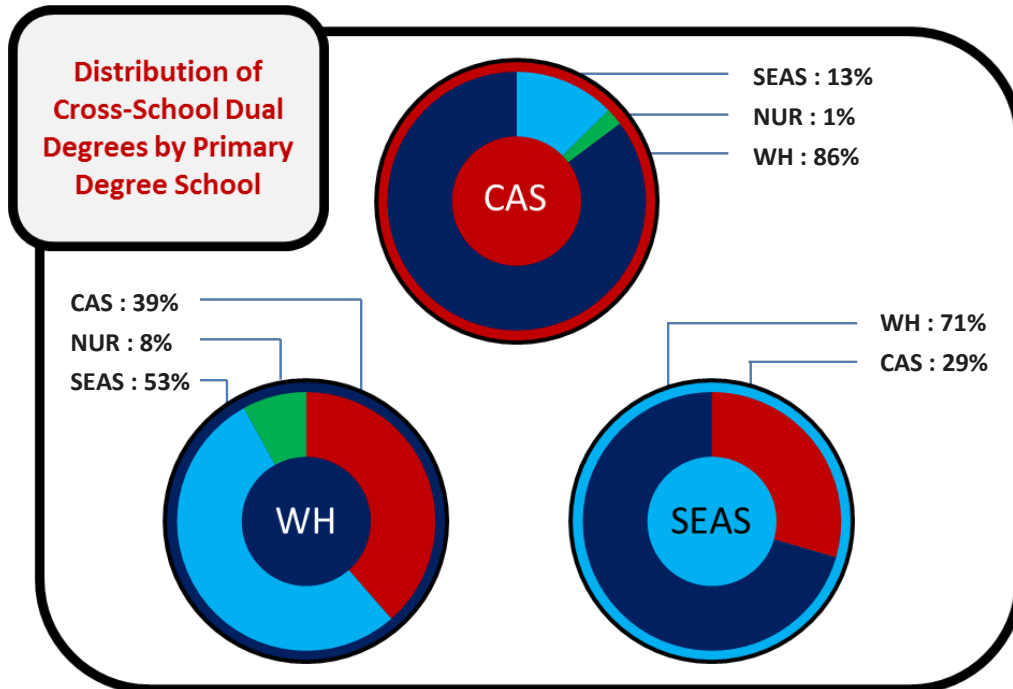
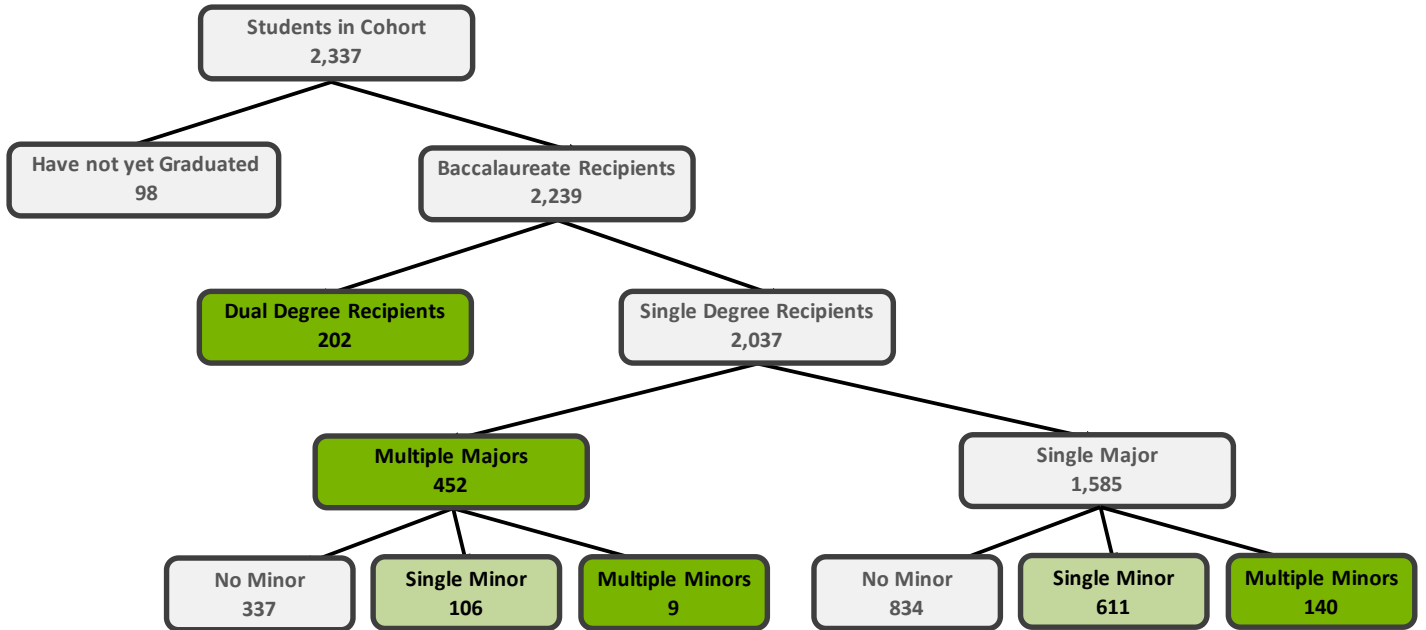


Figure 5.4 presents the distribution of dual-bachelor degrees across schools for 1998-2008 in graphical form, with percentage distributions of cross-school degree students as a function of primary school (large, central disks) and second degree (pie divisions). For absolute numbers, see Appendix 5.2—Charts and Tables for Integrating Knowledge. From the chart, we can conclude that the Wharton School is an especially attractive option among Penn students seeking a second degree. In addition, we can conclude that students in the School of Nursing are less likely than others to pursue a second degree. However, Nursing students have been completing minors in greater numbers since 2001, usually in the College.

Minors represent an important means by which Penn students formally integrate knowledge. They enable students to pursue secondary areas of interest, develop knowledge and skills that complement their majors, express themselves in a creative area that could become an avocation, and learn more about themselves and their culture. When pursued as a minor, such areas as foreign languages, mathematics, and computer science, among other fields, can also offer skills useful to students as they seek employment. A minor generally requires approximately half the number of courses as are required for a major in the same field. As shown in Figure 5.5, nearly 50 percent of undergraduates that declare only a single major finish at least one minor.

Figure 5.5

Traditional First-Time, Full-Time Undergraduates Entering Fall 2006



Taken together, minors, dual majors, and multiple majors ensured that nearly 63 percent of the 2006 Cohort who completed bachelor's degrees integrated knowledge via one or more of these means. Given that majors at Penn are constructed to engage outside disciplines through cognate requirements, as well as the fact that all four undergraduate schools ensure interdisciplinary breadth through various distributional requirements (as detailed in Chapter 7: Assessment of Student Learning), the fact that a majority of undergraduates take the further step of completing a minor or multiple majors underscores the extent to which available means of integrating knowledge are regularly accessed.

Strategic Considerations for Undergraduates

Strengthen awareness of double majors and minors in other schools. Notwithstanding the fact that most students at Penn already complete minors or multiple majors—and recognizing that dual major and minors have important trade-offs in necessarily reducing the proportion of course work available for free electives—the University could do more to increase awareness of opportunities to pursue double majors, especially across schools. The School of Engineering and Applied Science and the College of Arts and Sciences have recently permitted a second major in the other school. The Wharton School and the School of Nursing do not have majors and so do not have such arrangements with other schools. Nursing offers minors to undergraduates in all four schools and Wharton offers statistics as a minor to all undergraduates and participates in several of the [University minors](#). The opportunities available to undergraduates for cross-school study should be better promoted through each school's academic advising programs.

Strengthen opportunities to integrate knowledge through a minor. All schools and departments will do well to carefully consider their offerings for minors in terms of student demand and the quality of educational experience. Careful attention should be paid to the potential addition of minors that are not currently part of the curriculum. Consideration should be given to how students with different backgrounds, training, and skills could handle the course work required for a minor.

Create easy-to-find information about curricular and co-curricular opportunities for integrating knowledge. One important way to advance the integration of knowledge without the restrictions and limitations imposed by formal dual-major and minor programs is to promote inter-school and co-taught courses along with various co-curricular opportunities. Undergraduates, advisors, and program directors could be marshaled as valuable informational resources, and websites devoted to integrating knowledge could provide examples of novel combinations for emulation, along with career paths opened up by these combinations.

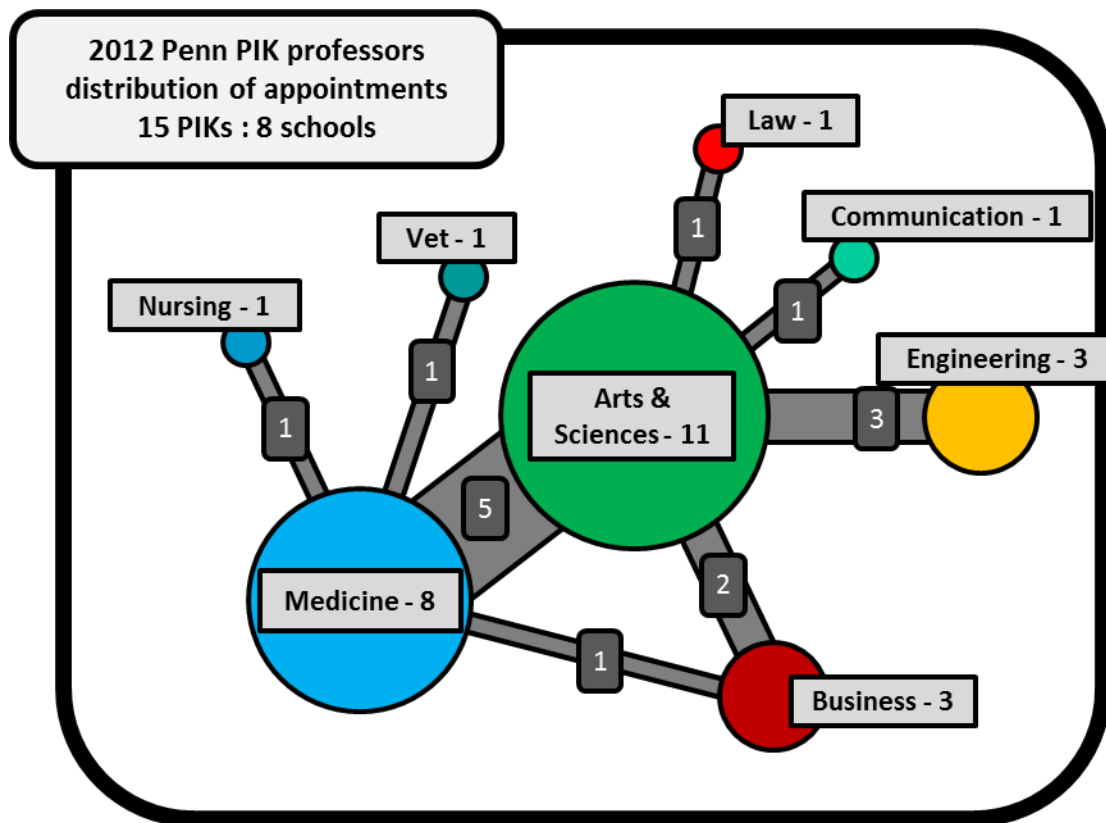
Increase funding for honors theses. A small amount of funds might be made available to students who wish to write a thesis that integrates knowledge. Such theses should satisfy certain criteria, such as involving at least one faculty member from each discipline.

Prize for best thesis. Funds should be raised for an award for graduating seniors to recognize the best thesis that exemplifies integrating knowledge.

Faculty

The [Penn Integrates Knowledge \(PIK\)](#) program was conceived by President Gutmann in 2005 to recruit teacher-scholars whose transformative work crosses traditional boundaries. These PIK Professors, each funded by an endowed University chair, are exemplars and ambassadors of integrating knowledge within the Penn faculty. They are appointed jointly between two of the twelve schools at Penn and recruited with the mission to exemplify integrating knowledge in the classroom, laboratory, or public sphere and with explicit descriptions of their expected role in integrative educational activities. To date, 15 PIK professors have been appointed, setting up a web of interactions among Penn's schools (Figure 5.6).

Figure 5.6
2013 Penn PIK Professors Distribution of Appointments



The PIK Professors program is one of several key initiatives to integrate knowledge through targeted faculty recruitment. When Penn created the PIK program, the Provost's Office also facilitated joint appointments of faculty across the schools, which have responded by making additional cross-school appointments to advance interdisciplinary research and teaching. For example, the School of Arts and

Sciences has approved a small number of multi-year “cluster” searches centered on a single academic theme (such as evolution, energy, and Asian religions) that enhance research and teaching across multiple departments. In so doing, the School seeks to:

- Identify key subfields or themes that will add depth and breadth to the overall academic profile of the school and its departments;
- Promote sustained interdisciplinary activity by adding faculty who will support long-term engagement in a given area through involvement with programs, centers, or faculty working groups;
- Maximize resources by investing in areas important to multiple departments and programs.

These activities explicitly support the definition of integrating knowledge described earlier: utilizing connections between disciplinary strengths to tackle wide-ranging intellectual and social issues through teaching and research.

Many Penn faculty engage in the work of integrating knowledge beyond these formal programs. Much of this work reaches undergraduates through the integrated courses of study detailed in the Appendix: Chart of Programs. There are often only one or two core faculty members associated with a given program, and these faculty members usually, and appropriately, have a reduced teaching load if they are directing such a program. Ideally, departments with a stake in a program would work with other departments under the leadership of the program director to staff a stable and well-conceived curriculum for the multidisciplinary program.

Open Learning and Modular Courses to Integrate Knowledge

[Penn's founding partnership with Coursera](#) to offer MOOCs (massive open online courses) to the public for free, and the University's broader effort to advance open learning, have played an important role in instructional innovation and integrating knowledge at the undergraduate level. Half of the Penn courses that have been or will soon be offered on Coursera are strongly interdisciplinary or taught by professors with multiple department/school affiliations. The use of modular, online materials simplifies the integration of knowledge, since the modules are short and can be viewed by students outside class time, giving professors greater freedom to reference material outside the strict boundaries of a discipline. For example, a mathematics course could more easily include applications in economics or biology by linking to a video module that applies the concept in another modular course.

Such modular online materials can be used to develop new methods of active classroom learning, in which some or all lecturing can occur outside class time, allowing class time to be spent in more interactive problem-solving and dialogue. Such methods permit more attention to integrative aspects of a course, which could otherwise be less of a priority given time constraints. Modular content may also encourage teaching collaborative or cross-disciplinary courses, as it permits importation of relevant lecture materials. Penn's selection as an AAU Project Site for the Undergraduate STEM Education Initiative will involve a great deal of activity and assessment related to the active classroom (Appendix 2.1).

Recommendations

Penn has made significant strides in advancing the integration of knowledge and will continue to invest in and prepare for a future in which the active connecting and fusing of distinct disciplinary ideas becomes all the more critical. Such investment has taken the form of new infrastructure, such as the new Singh Center for Nanotechnology and the soon-to-be-constructed Neural and Behavioral Sciences Building; faculty hiring practices that prioritize interdisciplinary opportunities and strengths; and undergraduate programs that provide the structures for students and faculty to integrate knowledge.

To capitalize on these advances, the Office of the Provost, the Council of Deans, the Council of Undergraduate Deans, and the Undergraduate Working Group are developing means to strengthen the review of cross-school and interdisciplinary programs, plan for new programs, and improve efforts to collect and analyze information about the ways in which Penn undergraduates integrate knowledge across campus. These coordinated efforts should continue to guide strategic decision-making and to ensure efficient use of collective resources.

Within the schools and departments, it will be important to identify the most promising areas for impactful, integrative scholarship and teaching and to prioritize these areas in faculty development (e.g., as the School of Arts and Sciences has attempted through cluster hiring). To this end, schools might profit by obtaining from their faculty members, on a regular basis, information about any activities (research, teaching, or service) that are multidisciplinary in nature and with which other schools or departments such activity is conducted.

Penn should continue to lead instructional innovation, including developing new methods of active classroom learning and using open learning initiatives to stimulate new forms of teaching and learning on campus. Critical to this effort will be continued collaboration among the Center for Teaching and Learning, the Penn Libraries, and the Penn Open Learning Initiative, carefully coordinated by the Office of the Provost and in regular communication with the Council of Deans and the Council of Undergraduate Deans.