CUR Quarterly

COUNCIL ON UNDERGRADUATE RESEARCH

Fall 2015 Issue | Volume 36, Number 1

ETHICS AND THE RESPONSIBLE CONDUCT OF UNDERGRADUATE RESEARCH

Also in this Issue

Modeling Undergraduate Research: Matching Graduate Students with First-Year STEM Mentees

Using *COEUR* to Assess the Undergraduate Research Environment: A Three-Stage Model for Institutional Assessment

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CUR Quarterly

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Cover Photo:
Biology major Alex Quakenbush collaborates with her research mentor, Dr. Amelia Ahern-Rindell, in the genetics laboratory at the University of Portland.

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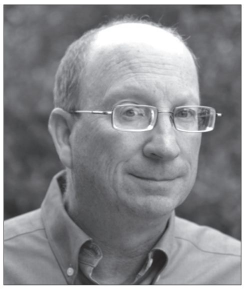
From CUR's President



It is an honor and a privilege to serve as CUR's 29th President. When I joined CUR at the first biennial conference, at Colgate University in 1985, I could have scarcely envisioned being in this position or have predicted the influence that CUR would have on my career and my involvement in research with undergraduates. Nor would it have been possible to foresee the dramatic changes in CUR in three decades. In 1985, there was one disciplinary division (Chemistry); now there are 12 (and more on the way). In 1985 we had perhaps hundreds of members from a few dozen institutions, mostly liberal arts colleges; in 2015 we have more than 10,000 members from more than 700 institutions, including community colleges, masters institutions, and research universities.

In 1985, CUR's activities were run exclusively by volunteers, and the official publication (a newsletter) was printed on letter-size stock folded in half and stapled. Today, we have a robust national office that manages a wide range of membership and outreach services benefiting faculty and students, including the National Conference on Undergraduate Research (perhaps the largest undergraduate research conference in the world), and we have a professional-quality publication in the *CUR Quarterly.* While CUR and its membership have significantly changed in many ways, it mission has remained constant—to support and promote high-quality undergraduate student/faculty collaborative research and scholarship.

My personal dedication to undergraduate research has its roots in my being plucked by the professor teaching my cell biology class in my junior year in college and summarily informed that I would begin a research project in his laboratory forthwith. My memories of my actual research productivity then are a bit hazy, but the transformative nature of being associated with real scientists doing real research, and arguing about science every Friday afternoon in group meetings was intoxicating: It changed the direction of my career. Likewise, my membership and service in CUR have been similarly transformative. I suspect that my experience with CUR is not unique. Early in my career, individuals and programs within CUR provided critical information, advice, and role models to help me initiate and sustain productive scholarship with undergraduates. I realized then that I was not alone in the questions I asked or the challenges I faced. Later in my career, I found myself returning the favor by sharing my experiences with others as a CUR councilor and institute facilitator.

The need for CUR's voice to be heard is more urgent than ever, especially in light of the national conversation about the role and cost of higher education. This conversation does not always acknowledge the importance of high-impact educational practices like undergraduate research or the role of scholarship in disciplinary discovery and the development of young men and women capable of critical thinking.

This is an important juncture for CUR. We need to translate our past successes into the level of national recognition that will allow us to more effectively influence the national conversation about higher education and the role and importance of undergraduate research in it. We need to recognize that our membership demographics have undergone a significant shift, in both size and breadth of institutional diversity. We must be proactive in reaching out to and engaging this changing and growing membership, since many members may not yet be fully aware of all that CUR has to offer. We also need to invest in assessment of the efficacy of undergraduate research, in order to more effectively advocate for the relevance of undergraduate research in higher education. As I reflect on the changes CUR has undergone in the last 30 years, I am confident that CUR will be able to adapt and thrive in fulfilling its mission now and into the future.

One issue always facing us is teaching students about the importance of ethics in research. High-profile cases of research fraud regularly capture the attention of the scientific community and the general public. In spring 2015, CUR surveyed its membership and discovered that members were eager to learn strategies for teaching undergraduates about research ethics. Indeed, there would appear to be no better time to educate individuals about research ethics than at the beginning of their research careers, as undergraduates.

This issue of the *CUR Quarterly* describes three such approaches to teaching research ethics. From Florida Gulf Coast University is a contribution that describes the use of a simulated funding panel to help students discover ethical and conflict-of-interest issues in research. Ami Ahern-Rindell and Alex Quackenbush of the University of Portland describe an endowed applied-ethics institute in which faculty/student teams engage in authentic ethics research in a variety of disciplines. Significantly, the inaugural faculty/student research led to internal recommendations about ethics education. Finally, from Kean University comes a description of a mandatory Research and Technology course, built in part around case studies, that delivers ethics education to all students. Readers will also find an additional contribution in *CURQ on the Web,* describing research and computer-ethics education woven into a summer research program. I hope these examples will spark interest in thinking about education in research ethics on your campus—and stimulate your ideas for how CUR can further develop its resources to support you.

Roger S. Rowlett
CUR President
Gordon & Dorothy Kline Professor of Chemistry
Colgate University

CUR Calendar

OCTOBER 2015

October 15-17, University of Missouri, Columbia, MO

Initiating and Sustaining Undergraduate Research Programs (ISURP). This institute is designed for campuses that are establishing new undergraduate research programs or centralized undergraduate research offices and those expanding undergraduate research opportunities from a single department to a campus wide program. It is also valuable for campuses interested in serving new student constituencies. Application deadline is September 12, 2015.

October 25-26, Hilton Arlington (Ballston Metro) and National Science Foundation. Arlington, VA

Research Experiences for Undergraduates Symposium (REUS). This conference features keynote presentations, presentations by students from REU programs in all disciplines, sessions for REU students, faculty, and administrators, and opportunities to present to representatives from NSF. Poster sessions will be displayed in the NSF atrium.

NOVEMBER 2015

November 6-8, Greensboro, NC

Creative Inquiry in the Arts and Humanities Institute. This institute will assist campus-based teams in developing transformative opportunities for Undergraduate Research, Scholarship, and Creativity (URSC) in the arts and humanities. The goal of the institute is to inform participants about current research on learning outcomes for students engaging in URSC.

November 20-22, Denver, CO

Beginning a Research Program in the Natural Sciences at a Predominantly Undergraduate Institution Institute (BRP). The goal of the institute is to give individual pre-tenured faculty members the opportunity to learn from and discuss with experienced faculty how to establish and manage a research program with undergraduates. While at the institute, participants will also prepare plans for starting and/or advancing their individual research programs at their respective campuses. A range of topics will be covered during the institute that show ways to achieve career success in undergraduate research.

FEBRUARY 2016

February 18-20, Hyatt Regency Capitol Hill, Washington, DC

CUR Dialogues. This conference is designed to bring faculty and administrators to the Washington, DC metropolitan area to interact with federal agency program officers and other grant funders. Attendees will also have the chance to engage in several networking opportunities.

APRIL 2016

April 7-9, University of North Carolina at Asheville, Asheville, NC

National Conference on Undergraduate Research. Come celebrate the 30th Anniversary of NCUR! Student abstract submissions will be open from October 5-December 2, 2015.

JUNE 2016

June 26-28, University of South Florida, Tampa, FL

CUR Biennial Conference. This conference brings together faculty, administrators, policy makers, representatives of funding agencies and other stakeholders with an interest in doing and promoting undergraduate research. It features over 100 workshops, presentations by representatives of funding agencies, social interactions, and poster presentations.

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Claudia Knezek, Patricia Morreale, Ramaydalis Keddis,
and Roxie James, *Kean University*

CUR Focus

Ethics in Practice: Research and Technology

Undergraduate research is broadly defined to include scientific inquiry, creative activity, and scholarship that relates beyond science (Kinkead 2003). Original work, the foundation of research, is likely to occur as an extracurricular activity. Another aspect of undergraduate research is the mentoring role with faculty guiding and initiating the student into disciplinary methodology. Benefits of undergraduate students' participation in research include improved critical thinking skills and retention, as well as increasing student potential for graduate school admittance. While honors programs are natural sites from which faculty might recruit student researchers, students from at-risk or underrepresented groups are also viable candidates for the undergraduate research experience.

Courses for at-risk or underrepresented students differ from honors programs because they frequently include cognitive and skill development, structured experiences for continued growth, and opportunities for increasing students' academic independence (Kinkead 2003). Additionally, such students should receive assistance in writing, preparing research papers, modeling of research projects, and the introduction of research ethics early in their undergraduate experience. University writing programs appear to be ideal venues for addressing academic integrity, research using human and animal subjects in research, principles for accounting for grant funds, plagiarism, fabrication of data, and criteria for assigning authorship.

Ethical considerations are integral to the undergraduate research process. Gravetter and Forzano (2009) maintain that researchers have two basic ethical commitments: (1) responsibility to human and nonhuman participants in their research studies and (2) responsibility to the discipline for accurate and honest in reporting of research. The research process automatically places researchers in a position of control over individuals involved as subjects in studies. Therefore, undergraduate researchers have the responsibility to ensure the safety and dignity of participants, just as all researchers do. The campus institutional review board (IRB) supports research by ensuring that researchers are meeting their ethical responsibilities, including obtaining informed consent from individual research subjects, ensuring that subjects are not harmed, and ensuring fairness in selection of participants. Finally, it is the responsibility of the researcher to ensure that research reports are accurate and honest descriptions of the procedures and results appearing in research studies.

Similar to other colleges and universities, the School of General Studies at Kean University has taken on the challenge of requiring the research experience and education on research ethics for all undergraduates. Students must successfully complete Research and Technology, a sophomore-year, three-credit course designed as a multi-disciplinary program that emphasizes ethics and the research skills needed for success in students' majors. Six different courses have been developed at Kean, depending on students' anticipated majors. First offered in 2006, and updated in 2010, General Education (GE) 2024 is designated for majors in the College of Natural Health and Applied Science, while other sections (2021, 2022, 2023, 2025, and 2026) are reserved for students in various other colleges of the university (see Table 1 for the breath of ethical issues that are addressed). While this article provides examples from GE 2024, the course geared toward students in the School of Natural, Applied and Health Sciences (which includes majors such as computer science, biology, information technology, mathematics, and chemistry), the course structure for the other courses, known over all as the GE 202X courses, is comparable. As GE 2024 is required for graduation, approximately 250 science majors take the class each year. University-wide, more than 2,000 undergraduates annually take courses in the GE 202X series. Over all, the courses serve to introduce students to the research process and standard ethical practices outlined in Table 1.

Course Design

The standard Research and Technology course description for the science-related disciplines says:

> Research and Technology (R&T) will introduce students to research design and methodology, as well as to disciplinary and interdisciplinary perspectives of the research process. Students will learn how to design and implement a research project appropriate for their major discipline. Students will learn how to use technology for research and the communication of research results. Students will also learn how to critically evaluate the validity, reliability, and limitations of research results. Emphasis will be placed on adherence to the university's standards and academic integrity.

Table 1. Ethics Discussion Sessions, by Disciplines

Major	Ethics Panel Discussion Topics
Business	Enron Bankruptcy Scandal Madoff Ponzi Scheme
Biology	WW II Testing on Humans Tuskegee Syphilis Experiment
Chemistry	New Mexico Atom Bomb Testing U.S. Military Mustard Gas
Computer Science	Ariana 5 Disaster Identity Thieves
Information Technology	Facebook Privacy Violations Hacking and Spoofing
Mathematics	Pentagon Cheating Scandal Schön Scandal
Education	Atlanta Schools Trial Fraudulent Credentials
Humanities	Bioethics Issues Terri Schiavo Case

Objectives for all courses in the GE 202X series are based on previously learned reading, writing, and mathematical skills that students use to acquire research and professional interpersonal skills. As they progress through their academic careers, students are afforded the opportunity to broaden their research skills through participation in the Senior Capstone Program. After their graduation from Kean University, students' research and technology skills will continue to be integral to their success in careers and/or graduate studies.

The primary course requirement is submission of a basic research paper that includes an introduction, literature review, methodology/results, conclusion, and reference section. This assignment is worth 50 percent of the final grade. A corresponding oral presentation is worth an additional 20 percent of the final grade, while a variety of ethics-related exercises (peer-review activities, attainment of NIH certificates, conduct of interviews, and data-collection exercises) account for another 20 percent of the overall grade. Ten percent of the final grade is based on attendance, other baseline activities, and the grant-writing exercise.

A series of coordinated activities and Power Points (see Figure 1) were developed by faculty to support students in applying ethics as part of their research experience. The first phase of an R&T course is dedicated to understanding the research process, describing tools used for conducting research, and effectively developing a research proposal. During the second phase, students develop the introduction, literature review, and reference sections of their research work, as well as explore the differences between conducting qualitative and quantitative research. The third phase addresses the development of a methodology section and data collection for the research paper. The final stage of R&T involves analyzing data, discussing results (e.g., data analysis, findings, relationship to other studies) and completing the conclusion section for a formal presentation. Students are also required to participate in a team grant-writing exercise to identify potential funding resources for their research projects.

Figure 1. Research and Technology Course's Ethics Component

Phase 1 Understanding the Research Process	Turnitin Exercise Discussion Panel: Ethics Issues on River Pollution
Phase 2 Research Development & Literature Review	NIH Protecting Human Research Participants Certificate IRB Website Activity
Phase 3 Methodology & Data Collection	Case Study Discussion Exercise Interview Role Play Activity
Phase 4 Analysis of Results & Presentation	Inductive Coding Active Listening Exercise Grant Writing Competition

The Ethics Component

Twelve research activities involving ethics were developed or selected by the faculty for inclusion in this research-course curriculum (Table 2). When discussing regulatory agencies, the campus institutional review board (IRB) and the National Institutes of Health (NIH) are reviewed. The historical background that gave birth to standards in ethics is initially addressed through student participation in Protecting Human Research Participants, a certificate program available through the NIH Office of External Research (NIH 2011). Examples of coverage of ethical issues include the Tuskegee Syphilis Experiment (Gray 2002), the Nuremberg trials

(Persico 1995), and the Stanford prison experiment, a study in the psychology of imprisonment, where selected Stanford University students took on roles as either prisoners or guards. This experiment was stopped early, after just six days, as both the guards and prisoners quickly acclimated to their roles, demonstrating the situational attributes of human behavior (Haney et al. 1973). Presentation on the Stateville Penitentiary malaria experiments, in which prisoners were infected with malaria for the purposes of testing the safety and efficacy of anti-malaria drugs (Miller 2013), considered at the time to be ethical clinical research, and the Stanford prison experiments include clips from documentaries on the incidents that help to further the discussion and comprehension of students on why these regulations and governing agencies are important. Also, the three most common forms are presented involving ethical standards for dealing with human participants—regarding informed consent, protection from harm, and right to privacy. Examples of the forms are provided because all student researchers who interact with humans in experiments need to use these forms.

Table 2. R&T Course Schedule, Ethical Issues (General Education 2024)

Schedule	Activities	Ethics Assignments
Weeks 1-2	Objectives, Assessments, Nature and Tools of Research	Tools of Research: *NIH Certificate, Library, Online Databases, Turnitin Exercise*
Week 3	The Research Problem	The Research Process: *Sample Selection Activity*
Week 4	Review of Related Research	Discussion Panel Activity: River Pollution
Week 5	Peer Review of Research Drafts	*Peer Review Proposal Activity: Critique Exercise* Overview (Summarizing Articles, Quotes, APA/MLA Reference Review) – Turnitin Exercise
Week 6	Qualitative Research Strategies	*Data Collection Tools: Interviews and Survey Design-NIH Certificate* Psychological/Conceptual Research Process Interpreting Data
Week 7	Quantitative Research Strategies	Group Session: Research Designs- *IRB Search Exercise* Descriptive Research Designs Sampling Designs Nonprobability Sampling
Week 8	Writing the Literature Review and Methodology Sections	Ethical Considerations in Conducting Research: *Case Study Group Activities 1-3* Primary Secondary Data Validity and Reliability
Week 9	Working with Methodology Section	Ethical Considerations in Conducting Research: *Role Play Interview Session*
Week 10	Data Collection and Analysis	Methodology Report Activity
Week 11	Data Analysis	*Inductive Coding Exercise*
Week 12	Grant Proposal Development	*Team Activity:* Grant Development Power Point activity
Weeks 13-14	Research Presentations	*Active Listening Exercise*
Week 15	Assessment and Course Evaluation	*Presentation Assessment* *Portfolio Development*

An important aspect of introducing ethics to students is helping them grasp the concepts of academic and scientific integrity. When addressing scientific integrity, students have to submit their paperwork into plagiarism-check software (Turnitin) and participate in a class discussion on an actual drug-development controversy over streptomycin, involving

A Research and Technology student presents her work to the class, illustrating the threshold of responses received to a survey, conducted with the Institutional Research Board (IRB) approval and after the undergraduate researcher received NIH Humans Subjects Research Training.

Final presentations in Research and Technology include presentation of the research question, discussion of the research methodology used, and summary of the final results.

two doctors and Merck & Co., Inc. This example is native to New Jersey, where Kean University is located. Supplemental material used for this discussion is *Experiment Eleven* by Peter Pringle (Pringle 2012), an investigative journalist. Students are exposed to ethical issues and discuss typical problems that scientists encounter, spurring the students to reflect upon how research practices affect their own and others' behavior.

During the research-development phase of this course, students participate in a panel discussion on developing scientific research studies. Small groups are formed to develop research questions on ethical issues related to river pollution. Students often have difficulty in taking on the role of unbiased researchers, and this exercise provides much-needed practice. Furthermore, the activity enables students to develop a variety of viable research questions on one topic.

When students prepare to collect research data, they participate in a series of case study reviews that highlight marginal or potentially unethical research situations. They also participate in a role-playing activity involving conducting research interviews. Students participate in a scenario in which they present their research questions to another student and then are critiqued by the class. This exercise enables students to receive feedback on their interviewing skills and potential ethical concerns, prior to doing field work.

Since R&T students are required to perform survey research, an inductive-coding exercise is used to determine the results of open-ended questions. Small groups are used to review and confirm the responses that were originally received by the student researcher. A description of the procedure that the raters used to evaluate the material is included in the methodology section of students' research. This process helps to reduce a large set of data to a smaller variable for further use in the research study.

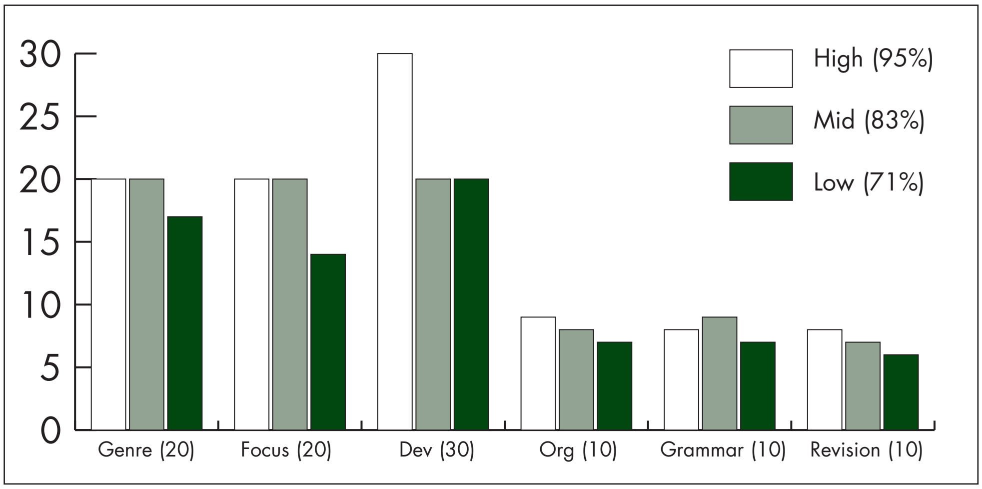
Active listening during student presentations is another way to determine whether or not student research is ethically viable. A speaker-evaluation form features a series of check-off responses to indicate whether or not the sources and/or student researcher speaking were credible, sufficient, and cited. If the standards were not met, the audience of student peer reviewers must provide written explanations of the deficiency level (for example, lack of citations).

The final requirement of the course is successful submission of the grant-writing assignment. Students form teams based on their areas of research and work to locate available funding on the grants.gov website. After research on the grant requirements and funding opportunities, students compile a slide presentation that includes background information on their projects, grant requirements of potential funders, a project budget, staffing patterns, and a timeline. In addition to ethical issues that are addressed in conducting research, student teams check for budget inflation, conflict of interest related to preparing the grant, and criteria on the formation of external partnerships. Uninvolved faculty members are used as judges to determine the best submission. The award criteria include compliance with codes of ethics, meeting grant requirements, and budget.

Best Practices

In fall 2014, a review team from the Accreditation Board for Engineering and Technology (ABET) visited Kean University to evaluate the Department of Computer Science for national accreditation. The process involved a thorough examination of courses, requirements, and assessment practices. The R&T course was part of the review, and the team recommended that Kean faculty present it as a best practice for sharing with

Figure 2. Differences in Writing Scores of R&T Students



Note: Accreditation Board of Engineering and Technology (ABET) Review Sample of High/Mid-level/Low Assessment Scores of R&T Students. Y-axis represents possible points for each category.

other universities. The evaluators reached this conclusion based on a representative sample of research reports.

A sampling of nine research papers was examined to determine the writing strengths of a group of S&T students (Figure 2). The high, mid, and low determinations were previously made by Kean faculty, in preparation for the ABET review. There was a 12-point difference between high- and mid-level scorers, as well as between mid-level and low scorers. Students scoring at the mid and low levels had difficulties in the development of their papers, while low performers also had difficulty with genre—which refers to the appropriateness of the writing for the intended audience, including the conventions and writing style expected while providing analysis and topic coverage—and focus and other areas.

Disseminating and Showcasing Student Work

The S&T course undergirds students' more advanced work. When enrolling in the senior capstone course during the senior year, approximately 10 percent of the former R&T students continue with their existing research topic to fulfill the course requirements. While all majors have a capstone course, the example here describes the capstone course for the biology major:

"The GE Capstone course, a culminating course for Biology majors, involves critical analysis of current topics in biology utilizing primary literature and integrating concepts taught in the Biology Core curriculum. Consideration will be given to social, ethical, philosophical and/or historical aspects of the life sciences. Format includes student presentations, reading-based class discussions, and library papers. The prerequisite for this course is twenty credits in the Biology core and senior status."

"In the Capstone, students are expected to complete a project using the skills developed through the GE Program to demonstrate mastery of their major content. The student project is either research or service-learning oriented and demonstrates attainment of the cognitive goals of the GE Program, the mastery of the skills developed throughout the GE Program, and knowledge/skills acquired through the study of a major. Capstone offers opportunities for students to integrate the GE experience with the major and work with students from other disciplines and cultures to investigate unfamiliar areas of interest."

The foundation established in GE 202X Research and Technology is used throughout the undergraduate experience, including summer research with faculty or final capstone courses. For computer-science and information-technology majors, the senior capstone course reinforces the initial ethics discussion used in the GE 202X course by providing students with the Association for Computing Machinery (ACM) code of ethics (ACM 1992), as well as review and discussion of the Institite of Electrical and Electronics Engineers (IEEE) Code of Conduct (IEEE 2014a) and Ethics Code (IEEE 2014b).

Kean University celebrates student and faculty research and creative activities during Kean Research Days, held annually for two days in April. The entire campus community is invited to attend. Poster sessions are reserved for seniors' research projects developed in capstone courses, with more than 100 undergraduate student posters displayed in this annual event. Additionally, in 2014 an afternoon session was designated to showcase Research and Technology students' research. More than twenty students participated in this

Table 3. Sample Assessment Scoring Rubric for R&T Students' Papers

Final Paper Title (maximum points possible)	Genre (20)	Focus (20)	Dev. (30)	Org. (10)	Grammar (10)	Revision (10)	Score (100)
The Impact of Math Education in the U.S.	20	20	30	10	8	10	98
The Status of Natural Disaster Preparedness	20	20	30	8	10	8	96
Heart Attack Prevention Among Young Adults in the U.S.	20	20	30	10	6	6	92
The Impact of Math in Society	20	20	24	6	8	6	84
What is the Impact of Overcrowded Emergency Departments?	20	20	18	10	8	8	82
How Does Proper Sleep Affect Health Among Adults?	20	20	18	8	10	6	82
Is a College Education Worth the Investment?	20	20	18	6	8	6	72
Vaccine: A Long-Debated Controversy by Parents	16	12	24	6	6	6	70
Brain Injury Among Adults	16	12	18	10	8	6	70
Average Total Score	19.1	18.2	23.3	8.2	6.8	6.8	82.8
Average Total Score Adjusted to Likert 1-5 Scale	4.7	4.5	3.9	4.1	3.4	3.4	4.1

event, in which their research was presented and critiqued by faculty and others in the university community. This public celebration of student accomplishment reinforces and shares best student practices in a transparent, accessible manner.

Since R&T is the equivalent of a sophomore-level course, the students' research is not usually publicly disseminated or showcased. However, students are required to develop an online portfolio of their research work that can be shared with invited guests (advisors or potential employers) during Industry Advisory Group meetings held by the student's major departments or shared with the Kean community. GoogleDocs is used to create student websites that contain discrete sections of their research studies: introduction, literature review, methodology, conclusion, references, and a sample survey.

Assessment of Undergraduate Researchers

Writing in R&T courses is assessed by using the students' final papers and the standard Kean University Writing Rubric. The paper must have properly formatted citations, as well as adhere to rules of standard English, grammar, spelling, and punctuation. Students are required to submit various parts of the paper throughout the semester. The writing rubric uses a five-point Likert scale to evaluate writing, and students are expected to achieve a three or higher score for each category. In 2013, a total of 581 students in 29 sections of Research and Technology were assessed on writing. The expectations of students achieving a 3.0 in all five areas were met by 82 percent of the participants.

A selected sample of scores (see Table 3) shows the diversity of topics, scoring ranges, and reconciliation between overall evaluation (100 points) and the Likert scale. Scores were initially awarded using the total points available (out of 100), and then converted to the Likert scale equivalent. For example, a score of 18.2 out of 20 for "focus" converts into a score of 4.5 out of 5 on the Likert scale. A score of 6.8 out of 10 for grammar translates into 3.4 out of 5 on the Likert scale. Genre, meaning appropriateness of the writing for the intended audience, received the highest score of 4.7, followed by a 4.5 score for focus, which indicated that students were clear and skillful in reaching their audience through writing. Also, development of the topic (3.9) and organization of the research paper (4.1) scores were relatively strong, with grammar and revision netting the lowest score of 3.4.

The overall R&T course results concerning students' skills in presenting their research proposals showed that eight in ten students received a 3.0 or higher in all areas, except only 76 percent reached that level for use of supporting material and 79 percent achieved that score for fluency. A recommendation was made by faculty teaching the course that earlier in the course students make mini-presentations of drafts of their research, to improve these results. Most importantly, a 97 percent success rate was achieved by students who completed the NIH Protecting Human Research Participants certificate program.

An additional pre-test/post-test exercise was administered to determine R&T students' knowledge of the scientific method, with students having difficulty, evident in the pre-test administered during the second week of the class, in determining the meanings of validity (37 percent of students) and reliability (29 percent). The post-test was administered at the conclusion of the class. Also, the Association of American Colleges and Universities (AAC&U) Quantitative Reasoning rubric was administered to assess the R&T research papers. Results showed that 84 percent of this pilot group using the AAC&U rubric had been weak in stating the assumptions their proposals were based on. The AAC&U Critical Thinking rubric was also used to assess R&T research papers and found many students had difficulty grasping concepts related to evidence and influence of the gathered data on the research outcomes (cause and impact).

Conclusion

The Research and Technology courses have been very successful in integrating ethics into the learning process for sophomores. Ninety-seven percent of the pilot group of 250 students using the AAC&U rubric in 2010 and again in 2012-2013, had earned the NIH certificate for Protecting Human Research Participants, which qualifies them to work with human subjects on research studies. Research ethics has been successfully incorporated into the undergraduate research experience at the sophomore and senior levels. Similarly, the student research website has become an important part of the course requirements in senior capstones, as students engage in career development and preparation for graduate education. This early use and reinforcement throughout the major permits undergraduates to be immersed in concepts of ethical conduct from the beginning of their research careers, with the credentials and expectations necessary to successfully carry out large research projects with professors as they advance through their undergraduate program.

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CUR Focus

Engaging Students in Ethical Considerations of the Scientific Process Using a Simulated Funding Panel

All undergraduates majoring in a physical or natural science in the College of Arts and Sciences at Florida Gulf Coast University (FGCU) are required to take an interdisciplinary-science methods course entitled Scientific Process. This course is designed to help professionalize students by introducing them to the history, practice, philosophy, and ethics associated with being a working scientist (Meers, Demers and Savarese 2003). Most students take the course early in their junior year as the first class in a sequence of research courses that culminates in conducting and presenting independent research during their senior year.

Scientific Process is typically delivered in a discussion format with two instructors from different scientific disciplines bringing their individual expertise to the course content. Presently, two to five sections of the course are taught each fall and spring semester; summer sessions tend to offer a single section of the course. More than 1,900 students have completed the course since the university opened in 1997.

Students' creation of a research proposal, where he or she demonstrates an ability to apply concepts covered in the course, is the primary assignment in Scientific Process. A student's proposal is a semester-long writing assignment that is modeled after the National Science Foundation's proposal requirements (e.g., NSF 2014). To complete the exercise, students must identify a research interest, review the relevant scientific literature, develop a focused research topic, design appropriate research methods, and then write a proposal for the study. Peer groups modeled on Chalmers "scientific communities" (1976) are formed early in the semester among students who share similar interests within the same section of the course. Students in the peer groups meet regularly in class to review and edit components of each other's proposals. These informal peer-review sessions help students refine their writing ability, critical thinking, and information literacy. In particular, they emphasize the need for students to communicate complex scientific concepts in a clear and precise manner, while being mindful of the author's audience. Students also experience the iterative process of edits and revisions that is integral to successful scientific communication and scholarship.

Scientific ethics are examined throughout the course, including a specific module near the end of the term that addresses overarching ethical considerations. Students learn how to engage the primary literature ethically, including the proper use of citations in the development of their research proposal. Students are also introduced to the scientific review boards that govern the study of humans (Institutional Review Board; IRB) and vertebrates (Institutional Animal Care and Use Committee; IACUC) in the United States. Each semester a representative from these groups presents an overview of each committee's role and functions. While students are not required to submit an IRB or IACUC application with their proposal, they must indicate whether one would be needed in actual research. During the module about ethics in science, students read and engage in class discussions that focus on a number of ethical considerations that scientists confront, including issues of fraud, financial conflict of interests, and scientific misconduct.

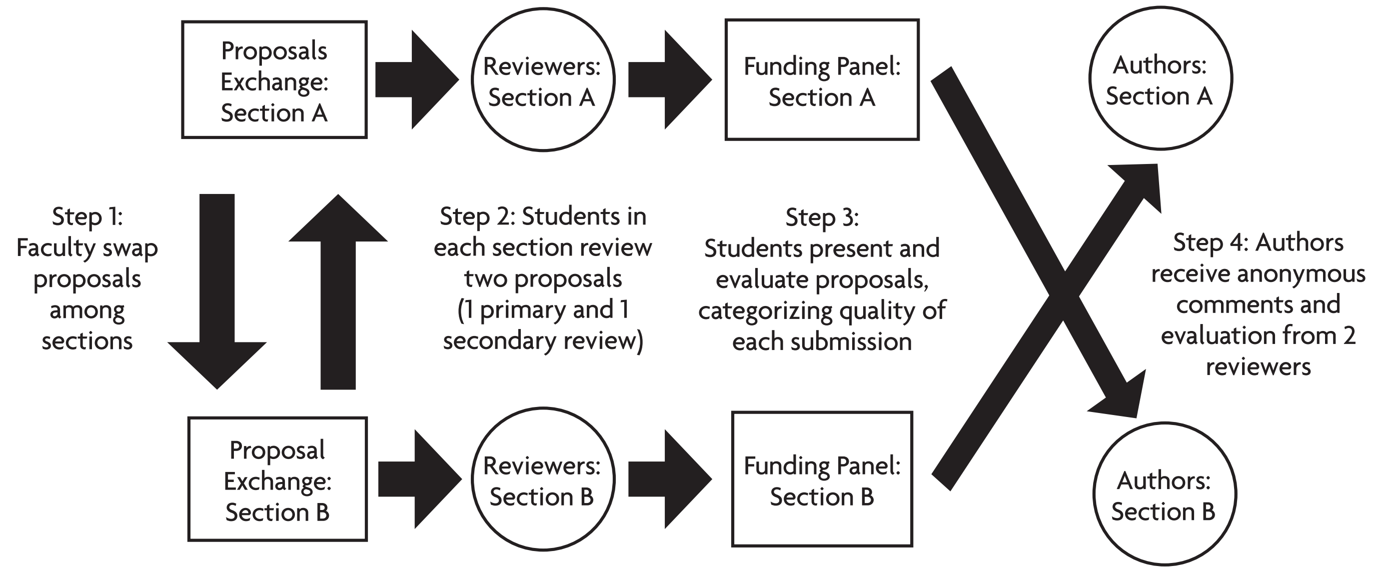
Simulating a Funding Panel

In 2010, faculty members teaching Scientific Process added a new component—a simulated funding panel. The goal of this activity was to enhance written proposals and improve peer reviews by the closing the loop on the proposal phase of scientific research. In this simulation, students conducted a formalized peer review of proposals from another co-occurring section of the course. The simulation occurred only after students underwent five to six editing sessions of their research proposals by their peer groups, which allowed them to better distinguish high- and low-quality proposals.

Substantial coordination among faculty members was then required to arrange reciprocal exchanges of student proposals across the concurrent sections of the course (Figure 1). Students were given access to all the research proposals that their section would evaluate via the learning management system. However, each student was only responsible for reviewing two proposals, serving as the primary reviewer for one and the secondary reviewer for the other. This resulted in all proposals receiving two independent reviews. Faculty members tried to match the subjects of the proposals that a student would review with that student's field (e.g., chemistry majors reviewed chemistry proposals). In addition, the process was conducted in a double-blind fashion, so that both authors and reviewers were anonymous.

The student reviewers were required to write a short summary of the two assigned proposals prior to the simulated funding

Figure 1. Logistic Plan for Funding Panel Simulation



panel, which could last as long two class meetings, depending on the number of proposals. During the meeting, each primary reviewer was allotted five minutes to present his/her summary, which highlighted the research focus of the proposal and outlined its major strengths and weaknesses. The secondary reviewer could then provide additional insights and clarifications that could either support or contradict the assessment of the primary reviewer. Then, the funding panel as a whole scored each proposal on four categories: not fundable (i.e., poor), fundable after major revisions (i.e., OK), fundable after minor revisions (i.e., good), and readily fundable (i.e., excellent). The top three proposals were forwarded to the faculty members in the section whose students produced the proposals for a final evaluation. Each meeting of the simulated funding panel was student-driven; the teaching faculty's role was to facilitate, but not direct, the meeting.

After completion of the simulated funding panel, each proposal's author received anonymous comments from both the primary and secondary reviewers and the "funding" decision made by the class section of students who reviewed the proposal. At the discretion of the course faculty, students who submitted one of the three highest ranked proposals in their class section received a "funding award." Students who received funding earned an "A" for the assignment and were not required to revise and resubmit a final version of their research proposal. All other students had to revise and resubmit their research proposals based on feedback received from the funding panel.

The funding-panel simulation described above has developed over time as faculty reflected on the experience. In addition, the simulation has been adjusted based on class size and the number of course sections offered during a semester. For example, the first iteration of the simulation did not include a double-blind review: student authors and student reviewers could identify each other. In addition, students in summer sessions (when only one section of the course was taught) exchanged proposals after the class was split into half so that the activity could include double-blind reviews.

Students in "Scientific Process" class evaluating proposals in a simulated funding panel (from left to right, Giana Barese, Stephen La Touche, Hugo Drago Jr., Lauren Tierney, and Sunni Whobrey)

Ethical Insights

The simulated funding panel was developed because it extended students' proposal-writing process to its natural and realistic conclusion. However, the rewards and challenges we faced in implementing the activity took the experience beyond our original intent. During the simulation, students had an opportunity to take an "outside look" at the peer-review process, which helped them discover many ethical considerations that scientists must grapple with in the real world, including issues of anonymity, bias, preparation, and civil discourse (Souder 2011).

Exploration of these ethical insights began with an anonymous survey that students completed after the funding-panel simulation. In the survey, students used a five-point Likert scale to indicate their agreement or disagreement with statements about the value of the experience and the effect of the experience on their writing and scientific understanding. With the exception of one statement concerning anonymity, the survey statements did not address ethical issues associated with the peer-review process.

Overall, students found the experience rewarding (Table 1). The vast majority of students (89.5 percent) strongly or somewhat agreed that the experience was valuable. Students also believed that they learned more about writing and the scientific process from participating in the simulation (83.1 percent and 69.6 percent, respectively, strongly or somewhat agreed). In addition, students felt that they reviewed proposals about subjects that aligned with their own interest (61.8 percent strongly or somewhat agreed), and students thought that they were well prepared, having read their two assigned proposals carefully (93.3 percent strongly or somewhat agreed). Finally, a minority of students thought that the experience would have been different if names of the author and reviewer were unknown (36.6 percent strongly or somewhat agreed).

Students also had the opportunity to explain their thoughts in one- to two-sentence free responses after each question (Table 2). These responses were analyzed using a grounded theory approach that allowed patterns pertaining to ethical implications to emerge without a priori hypotheses (Glaser and Strauss 1967). The most frequent student comments described improved learning, writing, and critical thinking (N = 107) and increased understanding of the peer-review process and grantsmanship (N = 96). Students also identified ethical considerations associated with the peer-review process, including concerns about anonymity and associated bias (N = 59); complications related to reading a limited sample of submissions (N = 35) or incomplete preparation/training (N = 27); and problems emerging from a lack of civility (N = 13). Students then engaged in a post-funding panel discussion, in which they had the opportunity to reflect on ethical matters and implications associated with the peer-review process. Faculty corroborated student-identified ethical implications from the survey during these post-simulation class discussions.

The lack of anonymity in the peer-review process was the most common concern that students expressed. Students described problems associated with transparency that occurred because the simulated funding panels took place among concurrent sections of the course; some reviewers determined the identity of student authors even though efforts were frequently made to create double-blind reviews. For example, one student described the difficulty reviewing someone whom he or she knew: "I knew the author of one of my reviews well and it definitely changed my thought process."

Table 1. Summary of Student Responses (%) to the Funding Panel Simulation

Statement	N	Strongly Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Strongly Agree
The funding panel was a valuable learning experience.	238	0.8	2.1	7.6	52.9	36.6
I learned more about writing an effective proposal by participating in the funding panel.	237	1.3	2.5	13.1	53.6	29.5
I learned more about the process of science by participating in the funding panel.	237	1.3	6.3	22.8	47.2	22.4
The subject of the proposal I reviewed was similar to my research interests.	238	7.2	15.1	15.9	43.3	18.6
I was well prepared for the panel; I carefully read both of my proposals.	237	0.4	1.7	4.6	35.3	58.0
The process/experience would have been different if the name of the person you were reviewing was unknown – that is, if both the reviewer and reviewee were anonymous.	238	8.0	34.5	21.0	22.3	14.3

Table 2. Students' Most Frequently Cited Insights, Suggestions, or Criticisms Regarding the Funding Panel Simulation

Described improved learning, writing, and/or critical thinking (N = 107)
Identified increased understanding about the peer review process and granting in science (N = 96)
Expressed unease about the potential lack of anonymity and/or associated bias (N = 59)
Wanted to be able to read more or all proposals (N = 35)
Described a positive, non-specific experience (N = 32)
Requested additional training before conducting a funding panel (N = 32)
Needed more time or better preparation prior to the funding panel simulation (N = 27)
Voiced alarm about minimal effort observed in some submissions or funding panel participants (N = 19)
Stated concern about the civil discourse of the peer review process (N = 17)
Desired a better alignment between their interests and/or knowledge and their reviewed proposal (N = 13)

Note: 200 of 238 students wrote at least one comment in the post-funding panel survey.

This transparency seemed to create cooperative conditions among some reviewers and student authors as evidenced by one reviewer who wrote, "It was hard to know that we were judging our friends and [we] may have felt pressured not to be harsh [because] we're all peers." Other students noted that transparency could actually lead to harsher reviews. For example, one student reviewer wrote, "It is tempting to look up people we are reviewing on Facebook. I might have graded more harshly/meanly." This student also illustrated how a few reviewers used social media to learn about the student authors.

Students also identified specific biases. Many examples of bias were ad hominem arguments (Souder 2011) that actually appeared to benefit, instead of harm, student authors. Some reviewers described sensitivity to student authors who seemed to have learned English as a second language. For example, said one reviewer, "The paper appeared [to be] written by an author where English was potentially not [his or her first] language. Seeing a foreign name made me be gentle in the delivery of recommendations." Other reviewers mentioned a gender bias, with one saying, "The only bias is that I am slightly more partial to females." Students also identified an age bias that is typically found in many academic institutions and disciplines. Just as some funders provide advantages to junior faculty members and researchers, including for example, the National Science Foundation's Faculty Early Career Development (CAREER) Program and the National Institute of Health's Pathway to Independence Awards, students recognized a need to accommodate lower-level authors, as evidenced by one student who wrote, "I did feel like I rated the sophomore proposal lighter than the junior."

Because the value or importance of the proposed research is key to a successful proposal, having disciplinary experts review the work helps assure that proposals are reviewed and judged fairly. Just as scientists do not feel qualified and are sometimes reluctant to review and make recommendations on work outside of their expertise (Lee 2006), our students felt that their lack of preparation prevented them from fairly reviewing proposals that were not similar to their own backgrounds. As one student said, "only the topics the reviewer is familiar with should be graded by the review[er]." Other students described the perceived subjectivity associated with the incomplete peer-review process, in which each student reviewed only two proposals. Said one student, "We basically just pick the paper we liked best, we didn't have time to break it down nor truly decide because I didn't even read the one we funded so it was a group vote that was bias[ed] based on readers['] opinion."

Similar to the research community (e.g. Tobin 2000; Weber, Katz, Waeckerle and Callaham 2002), students recognized the importance of civil discourse in producing the highest-quality peer review. In some cases, students recognized problems associated with an overly critical review process as evidenced by one student who wrote, "I think we should be required to point out the good things rather than bash [reviewed proposals] completely." In contrast, other students were concerned by the overly generous reviews that provided insufficient criticism to authors. For example, one student wrote, "Our group seemed to be too lenient so the proposals reviewed did not get the best feedback possible." In either situation, students expressed concern that some authors might ignore reviews of their work because of the tone of the peer review, resulting in a compromised process.

Broader Implications

Implementation of the funding-panel simulations was intended to introduce another part of the scientific process and further the development of peer editing. At the time, we, the faculty, did not anticipate the power that this simulation would have for engaging students in discussions about ethics. However, we found that this type of pedagogical innovation had serendipitous impacts. Students discovered ethical implications associated with the peer review process because they participated in a realistic process rather than just reading a case study that exposed them to scientific ethics. We have continued to implement the simulation, partly because of the ethical issues that students engage, but also because this activity illustrates the full scientific process and ties the course together.

There have been logistical challenges to organizing successful funding panels. To align student interests, teaching faculty had to be available to meet and decide which proposals should go to which students. We also had to ensure that each student received his or her two assigned proposals for review. This has been done best electronically through our learning management system. Faculty members also needed to reserve space so that each funding panel had access to a private room. Reviewers' comments and funding panels' decisions then needed to be routed back to authors so that every student could read and reflect on reviews of their work. Again, we found that electronic submissions in which students were asked to type out their comments and submit their reviews online were most effective.

Each panel consisted of at least two reviewers with expertise in the subject area of each proposal. However, faculty members also endeavored to insure that each funding-panel meeting consisted of students who possessed a range of scientific interests. Pulling students together from different backgrounds assured that there was sufficient knowledge to judge each proposal among the group of student reviewers. Requiring students on review panels to communicate and compromise across disciplinary boundaries also allowed them to practice skills that promoted interdisciplinary science (Huutoniemi 2012).

Finally, we had to make arrangements on the few occasions in which a student did not receive a review because a peer failed to complete the assignment and/or attend the simulated funding panel. In these cases we asked suitable student substitutes to complete the additional peer review for extra credit. These events, while disappointing, also allowed for insightful discussions regarding "what happens when someone doesn't do his or her job." Fortunately, this situation occurred rarely. Students appeared to feel an obligation to support peers; students recognized the benefit from the feedback they received from high-quality peer reviews. In addition, the funding-panel simulation created a sense of competition (i.e., "Who's going to get funded?") that invigorated student participation. Finally, the funding panel has worked best when proposals have been exchanged among students in two or more sections of the course, instead of among students in the same section of the class.

The simulation has been sustainable because of the benefits that it has provided to both students and faculty. For example, students have produced higher-quality research proposals as a result of the funding panel, making the final assessment easier and more rewarding for faculty. As importantly, faculty members have expressed appreciation for student interactions, as well as the collaborative teaching environment. For example, the funding panel has made students responsible to each other while giving them appropriate freedom of action to facilitate learning. The activity also initiated the unit on ethics by providing a practical and immediate experience that focused subsequent discussions, which helped students transition into functioning professionals. In addition, the activity has been cost neutral. As a result, it has not required additional financial support from the college.

Similarly structured exercises should be able to engage students with real-life ethical implications in any environment in which students produce a scholarly product. For example, the exercise could be transferred to any STEM (science, technology, engineering, and mathematics) class in which students submit a written scholarly assignment, such as honors theses or the research posters produced in many capstone experiences. With small modifications, the exercise should also fit the needs of any other discipline that engages students in scholarship. For example, students in creative writing could be brought together in a simulated editorial board to evaluate poetry submissions for an undergraduate literary journal. Similar to the funding panel, submissions would need to be reviewed by students in different sections of the same course. Students would then gather to discuss each submission and rank the relative quality of the different submissions. Highly ranked submissions could then be published if the campus had such a journal. Students could still benefit, however, even if the journal were only hypothetical. Similar to our STEM undergraduates, these creative writing students would be expected to produce higher-quality products and learn more about the peer-review process and its associated ethical considerations. To fully engage students in the ethical implications of the discipline-specific peer review process, faculty could lead students in discussions about insights that they realized during the activity. Regardless of the discipline and the particular format of the simulated peer review, the significance of this activity comes from the fact that students make discoveries about ethical behavior and collaboration that develop through their own experience.

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CUR Quarterly
COUNCIL ON UNDERGRADUATE RESEARCH

CUR Focus

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Applied Ethics Can Foster the Teacher-Scholar Model and Impact Undergraduate Research Campus-Wide

The field of practical ethics brings together the fundamental axioms of ethics and everyday decision-making. No one would argue the importance of a well-formed conscience capable of grappling with large ethical questions. However, it is equally and perhaps even more important to be able to make sound judgments about day-to-day matters. Formal ethical training for undergraduates often focuses on philosophical questions and hypothetical scenarios rather than on teaching individuals the skills they need during a typical day in their chosen career. This is problematic, since students will not necessarily be equipped to deal with practical ethical issues as they arise. Officials at the University of Portland (UP), a small, private comprehensive institution in northwest Oregon, recognized the disparity between their goal of developing morally minded students and yet not fully providing the training students need to practice ethical behavior while engaged in scholarly pursuits.

In response, UP partnered with a university regent and her husband, a 1963 UP alum, to create the Dundon-Berchtold Program for Moral Formation and Applied Ethics. An exploratory gift based on some thought-provoking conversations with the university's executive vice president and now president, the Reverend Mark Poorman, C.S.C., subsequently led the couple to provide additional funds to create a $4 million endowment for an institute. The program that is currently in place has a two-pronged approach: First, it fosters students' moral development utilizing a team-taught course with a reflective format, and second, it provides student-faculty teams with opportunities to conduct applied ethics-related research in the arts, business, education, engineering, health care, and the sciences. The endowment ensures that these two activities will continue to offer UP students the opportunity to participate in guided discussions on how personal value systems can influence one's character and to conduct scholarly work delving into the applied ethics relevant to their disciplinary specialization.

We believe this program offers a model for other institutions to learn from and emulate. To accomplish the two-pronged approach described above, this innovative program builds on the university's core requirement that all students take Ethics (Philosophy 220), which provides an introduction to the major themes in classical and contemporary moral philosophy. This sets the stage for an elective known as The Character Project (Theology 324/424), which President Poorman team teaches along with a couple of other faculty members and Dan McGinty, the newly appointed director of the Dundon-Berchtold Institute. The latter course is an introduction to the theological ethics of character and utilizes guided discussions about values, decisions, conscience, habits, virtues, and vices to explore personal identity and its development.

The institute's second focus, on scholarly work, is more relevant to the ethos of the Council on Undergraduate Research (CUR), which recognizes the synergy involved in the functioning of student-faculty research teams. By supporting the exploration of discipline-specific scholarship on ethical issues, the Dundon-Berchtold Program provides a venue in which faculty and students can advance their shared discipline in a meaningful way, gaining perspectives on issues of both scholarship and personal growth.

The Benefits of Undergraduate Research

Undergraduate research (UR) is considered one of the high-impact practices associated with deeper learning (Kuh 2008). Deeper learning is a developmental process wherein students learn skills of critical thinking that go beyond comprehension and conceptual understanding to more complex abilities such as application and integration. CUR defines UR as "an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline" (CUR 2011). It is an experience that involves a faculty member working with a student or a group of students on an original experiment, project, or creative product. Assessments of undergraduate research describe the many benefits to students and illuminate how they learn about the scholarship of their discipline (Lopatto 2003; Lopatto 2004; Laursen et al. 2010). UR experiences provide academic challenge, an enriching educational experience, active and collaborative learning, and close student-faculty interactions.

The most direct impact of UR is on a student's intellectual growth and cognitive development, but research experiences can also result in personal development. They can enhance confidence and self-esteem, and encourage other attitudinal changes that help students mature professionally. In the case of the University of Portland's Dundon-Berchtold Institute, the subject matter being investigated can also lead to a maturation of students' decision-making processes. This potential outcome is currently undergoing assessment and will be determined by longitudinal studies. By exposing students to ethical issues within their disciplines in a nurturing environment, one can help educate students on how to make good decisions and judgments in the future as they prepare for what they will encounter in their careers after college. Overall, UR leads to increased student engagement and closer connections to faculty, to other student researchers, and to the institution itself. Viewed across a campus, a culture of UR can enhance the intellectual and moral climate and provide benefits to all institutional stakeholders. However, it can be challenging to provide opportunities to all or even a majority of interested students, but initiatives such as the Dundon-Berchtold Institute can help reach more students.

Moral Formation and Applied Ethics

Student and faculty Dundon-Berchtold Fellows receive stipends for a year of collaborative work pertaining to applied ethics. Each student fellow is paired with a faculty fellow. To get the ball rolling at the beginning of the fall semester, faculty fellows participate in a series of seminar-like discussions led by the faculty member holding the university's chair of endowed ethics and a couple members of the Department of Philosophy, to reacquaint the faculty with themes and frameworks for ethical decision-making. This ensures that both the faculty and student fellows are prepared to conduct timely and potentially controversial research that can be informed by the practical application of discipline-specific ethical standards. The individual pairs work together throughout the year and also meet with all the paired teams as a group a couple of times in the spring to share thoughts about their experiences and the progress of their respective projects. One of the goals is that the fellows' work will provoke meaningful reflection and discussion that leads to transformative change (see Table 1).

Table 1. Summary of Goals for the Dundon-Berchtold Institute in Applied Ethics

Goal	Student	Faculty
Consideration and discussion of ethical issues in more courses		X
Awareness of ethical dimensions within discipline of study	X	X
Develop ability to conduct responsible research	X	
Make a contribution to the advancement of knowledge	X	X
Enhance the scholarly agenda campus-wide in relation to ethical practices	X	X

Some of these changes occur within courses when faculty make references to the research they are conducting as part of the ethics initiative. Describing these research experiences to their students in the classroom helps to bring ethical issues into the curriculum and provides meaningful examples that reflect reality. This is, in part, how students learn to appreciate that a discipline frames ethical issues through its own lens. It allows students to begin to comprehend how the knowledge they are acquiring, which is specific to their discipline, is used to inform how practitioners make decisions by utilizing facts and evidence acquired from research and scholarly endeavors.

The work of each pair of fellows culminates in a final report disseminated to the entire group of participants, the fund's benefactors Amy Dundon-Berchtold and James Berchtold, and other supporters during a banquet on campus, and then is externally disseminated in oral/poster presentations, performances, or published manuscripts. The disseminated research findings add to the scholarly work of each discipline and contribute to the advancement of knowledge. However, regardless of where research is undertaken, by whom, and for what purpose, the mere act of conducting research requires an understanding of acceptable practices that ensure the scholarly process is performed in an ethical manner with integrity.

Formal Ethical Training

The Dundon-Berchtold program enrolled its first cohort of seven faculty-student teams in academic year 2012-13 and sponsored nine teams during academic years 2013-14 and 2014-15. During the academic year 2013-14 the authors of this article represented the biological sciences as Dundon-Berchtold Fellows. The title of our study and the subsequent presentation student researcher Quackenbush made was "Designing an Ethics Tutorial for Students Engaging in Undergraduate Biological Research" (Quackenbush and Ahern-Rindell 2014). Quackenbush received the Rita W. Peterson Award in Science Education for this work, and as a result of our study and the resulting recommendations, in the future all University of Portland students, faculty, and staff engaging in any form of research—regardless of discipline or intent—will receive formal training in conducting their scholarly activities in an ethical and responsible manner. Our study thus paved the way for a more concerted effort to ensure that all research conducted on campus will be ethically sound and compliant with federal regulations.

When UR is centered on ethical issues, it can push students beyond their comfort levels while at the same time teaching them technical skills associated with their discipline. In order to be successful scholars and educated citizens, students must possess an understanding of what are acceptable and unacceptable research behaviors. Our Dundon-Berchtold project proposal grew out of observations made of the undergraduate research environment in our university's biology department.

We currently require biology students to complete a safety tutorial in order to protect them and others from the inherent dangers associated with conducting lab and field-oriented biological study. However, aside from serving as models for our students on how to ethically perform scientific research, we have no formalized training in place to ensure that our students act with integrity and follow the code of ethics outlined for scientists (Resnik 2011). However, such training is vital if we are to ensure that our students learn how to practice science ethically as they engage in biology-focused study not only here on campus but also in preparation for graduate education and/or post-baccalaureate employment. Quackenbush and I wanted to encourage activities beyond just expecting our students to gain the required attitudes and practices by observing their mentors and imitating their behavior.

In the past, and far too often today, faculty hope that their students will come to possess an understanding of what constitutes acceptable and unacceptable research behavior simply by chance, possibly through osmosis or some ethereal force. This is not practical and certainly does not meet the standards required of grantees by the National Institutes of Health or the National Science Foundation (NIH 2009; NSF 2009). These federal agencies require researchers receiving their support to obtain training in the responsible conduct of research from an institutionally certified source. Appropriate content and method of delivery are left to the discretion of the institution. This mandate, and the lack of formal training available for students at UP, motivated us to frame our inquiry-driven research. We sought to find out whether intentional training in ethical research behavior is necessary, or if students actually pick up and internalize the appropriate behaviors required to practice science with integrity using the existing model, which we fondly call the "non-intentional" model.

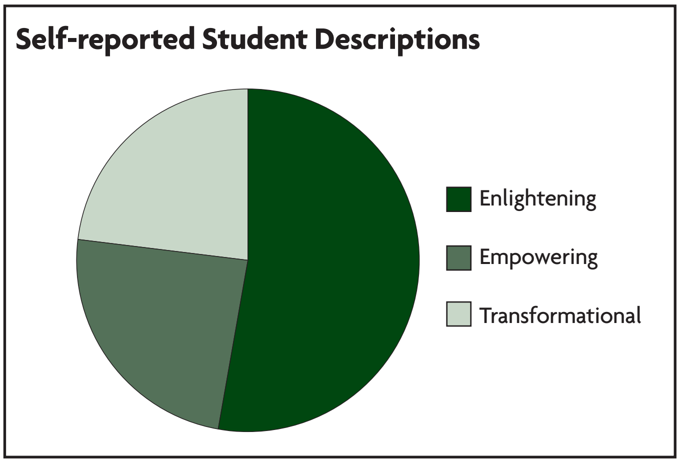
Ethical Research Behavior in Biology

Our approach utilized a qualitative survey we developed for our biology majors, and we invited students participating in UR in my Genetics Lab course and a couple of other research-focused biology classes to respond to our questions, which were approved by UP's institutional review board (IRB). The survey presented behavioral scenarios covering the topics of authorship and acknowledgements, collaboration, data management, experimental design, mentoring, peer review, plagiarism, and safety. Students were asked to read and then judge the acceptability of each scenario. If students knew all they should about ethical research practices, there would be

Table 2. Selected Behavioral Scenarios and Variance in Student Responses, by Topic

Topic	Behavioral Scenario	Number of Students Answering Incorrectly
Collaboration in a Research Team	A student is part of a research team including other students and a professor. This student works very hard on the project and obtains consistent and accurate results. When the other students on the team, who have not worked as hard, ask the student how his work is going, he makes an excuse for not sharing his results.	11/29
Data Analysis	A researcher is testing a hypothesis that she feels is highly likely, with the goal of submitting a manuscript for publication. She runs an experiment and collects precise data that seem to support the hypothesis. However, in order to make a statistically appropriate generalization, she would need a few more data points. Since she has no time to do more testing, she does not make any claims about her hypothesis in her paper.	10/29
Experimental Design	Suppose a field researcher is working in a community surveying people using various quantitative and qualitative questions. Some of the scheduled interviewees are close friends of the researcher. As a result, the researcher decides not to include them in the sample even though it makes the size sample too small to make any generalizations.	13/29
Authorship	A group of three students have been conducting research for over a year with their research mentor and are in the process of writing a manuscript to submit for publication. Their professor tells one of the students, Ellen, to be sure the order of their names on the paper reflects the amount of intellectual contribution made, in addition to the amount of laboratory work conducted by each student. Ellen decides that since they all contributed equally that she will just list their names in alphabetical order.	21/29

Figure 1. Student Descriptions Summarizing the Impact of Participation in the Dundon-Berchtold Applied Ethics Fellowship Program



little variance in responses. However, considerable variability was seen in the answers; there were no questions that were answered correctly by every student. We received twenty-nine completed surveys, a response rate of about one third. While this is a small number that limits our ability to make generalizations, the results provide useful information about questions of ethical conduct that are unclear for students. Areas of authorship, data management, and experimental design proved to be particularly troublesome (see Table 2).

Based on our results, we concluded that there are gaps in students' knowledge of ethical practices or uncertainty about the application of their knowledge of proper ethical research practices. These must be addressed for them to be truly successful in undergraduate research or in their future education or careers. The current model of learning by example is not sufficient. Thus, we recommended that the university adopt a web-based training program for responsible conduct of research. We are pleased that the university agreed with our suggestion and implemented a program to train students, faculty, and staff, as noted above. This online training became available to all university personnel in the spring 2015 semester. With UP's movement toward incorporating research directly into the design of content-driven courses, more students will become involved in research, thus underlining an increased need for formal ethical training. This may also encourage more students to participate in group and/or independent research. We recommend that institutions that have not already done so should adopt similar online training, especially if undergraduate research is expanding on their campuses.

Impact and Assessment

In addition to yielding the interesting results outlined above, our applied ethics research personally impacted us. The experience was powerful as it allowed us to participate in meaningful study of an ethical issue in our academic field. Dundon-Berchtold student fellows' responses to a survey after the conclusion of the research with their faculty mentor indicated that they appreciated this unusual opportunity for undergraduates and that this intensified their effort and investment in their own learning. Their responses implied that participation in the program had a significant impact on them; they used words such as enlightening, empowering, and transformational to describe the impact. (See Figure 1 for details.) These responses illustrate the effectiveness of the program in developing reflectively minded students who are more aware of applied ethics in their discipline.

As the faculty participant on the team studying biology ethics, I experienced benefits that aligned with, and reinforced, many of my professional goals as a teacher-scholar. As a geneticist/cell biologist with a longtime interest in bioethics, I have always been aware of ethical issues pertinent to my discipline. I include case studies in my courses to explore these issues and their potential implications with my students. I have also taught topic-specific seminar classes that have zeroed in on bioethical themes, including one on the ethical, legal, and societal implications of the Human Genome Project. I have researched the subject of how to incorporate ethics into the undergraduate biology curriculum since I believe ethics to be an essential component for science classes taught to majors and non-majors (Ahern-Rindell 1999). My scholarship relevant to improving science teaching also encompasses utilizing UR as a pedagogical tool. I converted my Genetics Lab course into an authentic, hypothesis-driven research experience based on my own research program (Ahern-Rindell 2015), and I offer numerous students opportunities to join my research group so they can benefit from this type of experiential learning. My participation in the Dundon-Berchtold program was a natural fit based on my academic credentials, interests, and teaching history.

As a faculty member I have experienced more than 20 years of varied interactions with students. These have ranged from being their instructor in the classroom, research mentor in the laboratory, academic advisor for course/career decisions, supervisor for teaching assistants and tutors, advisor for honors or senior theses, manuscript/presentation co-author, and chaperone during study-abroad activities or other university associated travel. Many of these close interactions with students resulted in bonding that has led to life-long friendships. I suspect that this will also be the case for this most recent experience with Alex Quackenbush as a team of Dundon-Berchtold Fellows. However, the bond that we, as collaborators and co-authors, have forged is somewhat different because of the sharing that occurs when discussing ethical issues, which generate more personal reactions. We developed a level of comfort and trust that was much less formal and more open than most student-faculty interactions. I believe we each revealed more about who we are as people than is customary in a faculty-student relationship. Although this made us more vulnerable as individuals, it also made the experience more rewarding because of the greater potential for personal growth and development.

A more comprehensive assessment plan for the initiative is in the planning stages and will specifically address how to accurately measure all the intended programmatic goals. The creation of the Dundon-Berchtold Institute for Moral Formation and Applied Ethics, and the appointment of its full-time director, will help to ensure that the necessary and important task of assessment is accomplished to help steer future strategic planning and implementation. An important aspect of the program that should be routinely analyzed is its overall quality. Different measures can be used to assess this. One measurable indicator of quality pertains to the extent to which the fellows' research findings are disseminated through the peer-review process. This can easily be quantified through conference presentations and journal publications. The authors, for example, made an oral presentation of their findings at the annual meeting of the Pacific Division of the American Association for the Advancement of Science (AAAS) in June 2014 in Riverside, California (Quackenbush and Ahern-Rindell 2014).

We anticipate that as the Dundon-Berchtold program continues to grow and touches more students and faculty, its benefits to participants and the UP community as a whole will increase and broaden. We hope this model program can serve as an example for other institutions and help encourage higher education in general to utilize the teacher-scholar model to effectively improve the intellectual and moral development of undergraduates.

The University of Portland's Dundon-Berchtold Faculty-Student Ethics Fellows, Dr. Amelia Ahern-Rindell and Alex Quackenbush, work together on designing a survey on proper ethical behavior when conducting biological research.

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Alex Quackenbush recently graduated from the University of Portland with a bachelor of science in biology and mathematics. She participated in the university's honors program, was a Dundon-Berchtold Fellow in 2013-14, and a Murdock Undergraduate Research Program Scholar in 2014-15. She founded and was president of the Undergraduate Research Club at the university and served on the UP Undergraduate Research Advisory Committee as a student representative. She will enter a graduate program in molecular and cell biology at Oregon Health and Science University this fall.

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Modeling Undergraduate Research: Matching Graduate Students with First-Year STEM Mentees

Finding innovative ways to integrate first-year students into research remains a challenge. Most students who become involved in research have to dedicate significant time to the research process, which has the potential to take away time from coursework. Here we describe a program that provides first-year students with a short hands-on experience—a research apprenticeship—in a research environment in the sciences, technology, engineering, or mathematics (STEM) fields. The Learning Environment and Academic Research Network (LEARN™) is a STEM living-learning community established in 2011 at the University of Central Florida (UCF). This program is framed around evidence documenting that early research experiences, living-learning communities, and mentoring can increase student retention. LEARN specifically aims to increase retention of first-year students in STEM fields, targeting first-generation students and those from underrepresented populations, by providing an integrated version of high-impact practices.

Participants live together, benefit from multiple mentors, and take Introduction to Research courses that feature research apprenticeships. The undergraduates are paired with graduate research mentors, who are formally trained. The apprenticeships last for 12 weeks and students engage in the research process for three hours each week. Graduate mentors work with their mentees on a variety of training activities. The mentees log their activities each week, and these logs have demonstrated that students can participate in a wide variety of experiences and are not simply doing mundane tasks each week. The graduate mentors are also having positive experiences and report that they gain important mentoring skills through the LEARN program.

Foundation of the Program

The research literature makes clear that undergraduate research is considered a high-impact educational practice (Kuh 2008; Boyer Commission 1998). Students benefit from increased confidence, strengthening of skills such as critical thinking and communication, and increased interest in graduate education (Lopatto 2009; Lopatto 2007). Research also shows that engaging in research early in a student's career can affect student success and retention (Hathaway, Nagda, and Gregerman 2002; Nagda et al. 1998; Hunter, Laursen, and Seymour 2007). However, finding good avenues for participating in early research remains difficult due to limited resources and a scarcity of faculty mentors.

Traditionally, the formal research mentor is a faculty member. However, faculty time is restricted and undergraduate training can be time consuming (Horowitz and Christopher 2013). Faculty often can only mentor a few students at a time and struggle to appropriately train new students (Adedokun et al. 2010). At research universities, especially in the science and engineering disciplines where research training occurs in a laboratory, graduate students often contribute significantly to the mentoring process by becoming "unofficial" mentors for many undergraduate researchers. By formally recruiting and training graduate students to mentor undergraduate researchers, the number of students involved in research can be increased and the experience of the undergraduate mentees and graduate-student mentors strengthened.

Graduate students can gain significant benefits by engaging in formal mentoring. Mentoring can increase graduate students' identities as scientists and their retention in the pipeline for research careers (Dolan and Johnson 2009). Formal mentoring builds graduate students' resumes, possibly making them stronger candidates for scholarships, fellowships, and jobs. Yet the qualifications and experiences of graduate students engaging in mentoring can vary greatly. Additionally, the type of research that graduate students are prepared to mentor (i.e., basic training versus independent projects) can be an issue.

We attempted to design an apprenticeship program that addressed these issues. In the LEARN program, the undergraduates in STEM courses work in research apprenticeships for three hours per week for 12 weeks. First-year students' engagement in research can provide many benefits (Hathaway, Nagda, and Gregerman 2002; Schneider, Bickel, and Morrison-Shetlar 2015), but conducting an independent project in the first year of college is a large task. This is especially true in STEM disciplines, in which training for laboratory research can be lengthy. Retention rates in STEM fields are often lower than for other disciplines, especially for students from underrepresented populations (Brown, Morning, and Watkins 2004; Hayes 2007), so balancing coursework with other academic engagement activities is a challenge. Thus our brand of "research apprenticeship" provides research exposure to first-year students with the goal of getting them involved and invested in their majors. However, this non-independent research experience still allows ample time to focus on coursework and adjustment to the university.

According to Lave and Wenger (1991) to be an apprentice is to engage in legitimate peripheral participation in a community of practice. Several other authors have discussed the research-apprenticeship model in terms of a research community of practice (Feldman, Divoll, and Rogan-Klyve 2013; Sadler et al. 2010). Feldman and colleagues explored a range of research experiences, and their findings suggest that undergraduates, in general, are in the role of apprentices in the research group environment. In a detailed 2009 review, Sadler and colleagues reviewed all levels of undergraduate research, lasting from two weeks to one year (most were full-time summer programs), and referred to all of them as research apprenticeships. In our program, however, we define the "research apprenticeship" as a short introduction to research to expose students to research but posit that it is not an independent research experience. The goal of our apprenticeships is to get students invested in their majors, using them as gateways to broader, independent research experiences.

LEARN Program Overview

The LEARN program was developed in 2011 through National Science Foundation funding and was sustained by the university in 2014. LEARN accepts 28 students from STEM disciplines into its community each year. It is run by the UCF Office of Undergraduate Research through a strong partnership with the university's Division of Housing and Residence Life. The participants live together in a university residence hall, take courses together, and are involved in the 12-week research apprenticeship. The program includes academic, social, and community-service programming. All undergraduate participants receive a small scholarship and priority registration for classes.

The program recruits majors from diverse fields within STEM disciplines. To date, 50.6 percent of participants have been from engineering or computer science, 37.3 percent from the life sciences, and 12 percent from the physical sciences or mathematics. Additionally, 48 percent of LEARN participants are first-generation college students and 77 percent have been from populations underrepresented in graduate education. The program has produced significant outcomes for participants such as increased retention and higher GPAs compared to a matched control group, as well as significant positive gains in critical thinking as measured by the Critical Thinking Assessment Test (Schneider, Bickel, and Morrison-Shetlar 2015).

Fundamental to this program are the Introduction to Research courses and the pairing of each undergraduate with a graduate mentor for the apprenticeship component. LEARN undergraduates are prepared for this apprenticeship by taking formal coursework—Introduction to Research I in the fall and Introduction to Research II in the spring—as a cohort. These one-credit courses provide detailed information regarding academic research and specific skill-building exercises to complement participants' apprenticeships. The apprenticeships are considered part of the course and start half-way through the fall semester. Early in the fall, the initial part of the course prepares students for research through seminars on the scientific process and the laboratory environment. The students also complete the university's laboratory-safety coursework. The second part of the fall semester, after the apprenticeship begins, focuses on building the skills that help the participants understand their graduate mentor's research. Students learn how to find, use, and read both primary and secondary literature. They have to search, find, and read literature related to their apprenticeship.

The content of Introduction to Research II in the spring focuses on a final project—a short research proposal related to the students' apprenticeship-research areas. These are separate projects that relate to their graduate mentor's research project. Preparing the students to undertake the proposal process occurs throughout the year, but there is a specific focus in the spring. Topics in the spring semester include technical writing, proposal components, how to create a poster, technology transfer (e.g., patents, copyright), and how to use their research exposure as a platform for additional opportunities (e.g., internships, summer research programs).

The proposal project is done in a stepwise fashion. Students start by developing an idea and then writing the introduction. Then they move into outlining research methods and expected results. At the end of the semester, the research proposal is structured into a digital poster to be shared with their peers. Students receive feedback from their peers, instructors, and the graduate mentors throughout the process.

Defining the LEARN Research Apprenticeship

Six weeks after they start their university careers, the participants start their apprenticeships. They complete the first part (five weeks) in the fall and the second part (seven weeks) in the spring; the apprenticeship ends before the university's spring break. The participants do not choose their apprenticeships; the program's staff assigns apprenticeships based on scheduling needs and students' majors.

The reason the research apprenticeship is limited to 12 weeks is to balance students' engagement in research with their coursework and avoid adding to first-year students' stresses. Graduate mentors are recruited from all disciplines represented in the LEARN participants' majors. To date, finding graduate mentors has not been a challenge in most departments, and every year graduate students are turned away. The requirements for becoming a mentor are fairly open. Graduate students must be on track with their thesis or dissertation and in good standing within their departments. Faculty advisors sign each graduate student contract with the program to ensure consent. When appropriate, two undergraduate participants are paired with one graduate student. To compensate the graduate students, small scholarships are provided—$300 for mentoring one student and $400 for two. The size of the scholarship was determined to be appropriate through informal conversations with the graduate mentors. The scholarships allow the graduate students to feel valued for their participation, but they do not appear to attract students who are just applying for funding.

All graduate mentors are required to attend a training session prior to the start of the apprenticeship to mediate some of the variability in mentoring abilities. The training is organized by the LEARN coordinators with support from the university's Faculty Center for Teaching and Learning and the Office of Diversity and Inclusion. Additional information about the training can be found in Bickel and Schneider (2013). Overall, graduate students have served the program well and have been ideal mentors for first-year students. Graduate students are closer to the first-year students' peer group than faculty and can relate to the undergraduate culture.

The undergraduates' experiences. The LEARN program ran formal focus groups for the undergraduate participants at the end of each semester in 2011, 2012, and 2013. These groups reviewed all aspects of the program, but specifically helped identify the strengths and weaknesses of the apprenticeships. Reports from the focus groups have shown that the participants generally enjoyed their apprenticeships, but that an individual's experience in the program was tied to the strength of his or her mentor. Mentoring has varied greatly among the graduate students, and the staff of the LEARN program has worked to improve the training of mentors each year (Bickel and Schneider 2013). The undergraduate participants are encouraged to share issues with the program coordinator, since the program does not have a formal channel to learn of difficulties otherwise. The graduate mentors provide feedback on their mentees three times during the year: two weeks, six weeks, and twelve weeks into the apprenticeship. They also grade their attendance and participation at the end of the fifth week and the twelfth week. Their reports are used for grading in the Introduction to Research courses, accounting for 35 percent of the one-credit grade.

What do the first-year students do during the apprenticeships? There were concerns prior to starting the program that the first-year students would only be used for laboratory-maintenance activities (e.g., making food, cleaning dishes, and organizing files). Maintenance activities are considered appropriate, since they are necessary components of the research cycle, but they are not the only activities the program coordinators want to occur during the three hours each week students spend in the apprenticeship.

To determine what LEARN participants actually were doing during the apprenticeships, the inaugural cohort in 2011 entered their weekly activities into a research log. These were

Figure 1. Weekly LEARN Apprenticeship Log Template*

Complete a trial, task, or experiment	Attend a lab meeting	Reading journal articles related to the research
Set up or design an experiment	Introduced to the equipment in the lab and what it does	Watching my mentor or another researcher complete a trial or task
Assist in lab maintenance (e.g., clean dishes, stock supplies)	Introduced to others in the lab or department	Review data sets or results
Finding research literature or other materials related to the research	Describing or showing the type of research that occurs in the lab	Attend a research presentation (e.g. thesis/dissertation defense)
Formatting or assisting in the writing of a presentation, poster, or publication	Explaining lab protocol and procedures (e.g. how to clean something or who to ask)	Introduced or practiced a technique/program/process/calculation used in research
Collect and record data	Learn about why the research or specific task was important	Learn about other research opportunities
List any other tasks you completed that are not listed above:		Discussed parts of a research paper or proposal
Date:	Time in:	Time out:

What did you learn this week?

____

*Student Instructions: For each week of the apprenticeship: (1) Fill in the time in/out and date; (2) circle or highlight all of the activities you completed while in the lab that week; (3) write a 1-2 sentence description of what you learned that week during your apprenticeship. Complete these three steps for each apprenticeship week.

open-ended so that students could record all of their activities. After the first year, the program moved to categorize the activities in order to understand the apprenticeships in more detail. These activities were categorized into three groups: assisting research, connecting to research and the laboratory, and learning about research. In 2012 and 2013, the students used a log, circling the activities they undertook and adding any additional activities to their log, as well as summarizing what they had learned during that week (see Figure 1). These categories were used in the mentors' training to help the graduate students explore activities they could do with participants.

The undergraduate participants in 2012 and 2013 were involved in a wide variety of activities during their apprenticeships (see Table 1). In fact, only 52 percent of the participants reported doing "maintenance" type activities one or more times, and only 17 percent did them more than five times. In addition, 92 percent completed an experiment or trial at least once, and 44 percent did so five or more times. Similarly, 90 percent of participants were introduced to equipment in the laboratory. (Usually 10 percent of the students are majoring in computer science or engineering and thus experiments and equipment are less likely to be part of their experience). In addition, 79 percent of the students discussed their research proposal or their final project with their research mentors, and 23 percent did this five or more times.

Only three "activities" were performed by fewer than 50 percent of the students. Just 42 percent of participants reported learning about other research opportunities. This is a bit low, and we plan to strengthen the "next steps" portion of mentors' training to increase the number of mentors who are discussing further research opportunities with their apprentices. In addition, just 44 percent of students reported formatting or assisting with writing of a presentation, poster, or publication. This actually is not surprising since this activity is usually done by more-advanced student researchers. Lastly, only 31 percent of students attended a research presentation.

Students were also asked "What did you learn this week" (see Figure 1) and were allowed to give specific details. Some examples of their responses include:

- Independently set up gels for electrophoresis
- Worked on a methods section (of a paper)
- Performed a mini-preparation with the separation of bacterial and plasma DNA
- Received tips for pipetting more efficiently in experiments

Table 1. Percentages of LEARN Undergraduates Performing Specific Apprenticeship Activities, 2013 and 2014 (n=48).

	One or more times (%)	Five or more times (%)
1. Assist in research		
a) Complete a trial, task, or experiment	92	44
b) Set up or design an experiment	77	29
c) Assist in lab maintenance (e.g. clean dishes, stock supplies)	52	17
d) Finding research literature or other materials related to the research	67	8
e) Formatting or assisting in the writing of a presentation, poster, or publication	44	4
f) Collect and record data	67	29
2. Connect to the lab		
a) Attending a lab meeting	67	6
b) Introduced to the equipment in the lab and what it does	90	17
c) Introduced to others in the lab or department	83	4
d) Describing or showing the type of research that occurs in the lab	83	13
e) Explaining lab protocol and procedures (i.e. how to clean something or who to ask)	65	10
3. Learn about research		
a) Reading journal articles related to the research	81	21
b) Watching my mentor or another researcher complete a trial or task	81	31
c) Review data sets or results	77	19
d) Attend a research presentation (e.g. thesis/dissertation defense)	31	0
e) Introduce or practice a technique/program/process/calculation used in research	98	33
f) Learn about why the research or specific task was important	85	15
g) Learn about other research opportunities	42	0
h) Discussed parts of a research paper or proposal	79	23

- Learned what exactly goes into becoming an electrical engineer
- Performed an experiment to extract parasites
- Distributed the resistors and capacitors to calibrate the readings of the water sensors
- Identified dung beetles
- Performed main functions in statistical analysis software
- Learned how to take water samples properly

The graduate mentors' experiences. The graduate-student research mentors were trained for five hours before the program began and were encouraged to contact the program coordinators throughout the experience, as needed. Before the second part of the apprenticeship begins at the beginning of the spring semester, the graduate mentors are invited to an informal lunch to discuss the status of the program. Typically, 50 to 75 percent of the graduate mentors attended each year. In this format, the program's staff meets face-to-face with the mentors only one or two times. At the end of the apprenticeships, the graduate students receive a 10-question, anonymous survey. Thirty of the 50 graduate mentors involved in the LEARN program from 2011 to 2014 completed the survey.

The multiple-choice responses are presented in Table 2. The mentors were at different stages of their graduate careers and had had a variety of previous experience with mentoring. For 33 percent of the graduate mentors, the LEARN students were their first mentees, but 23.3 percent had mentored more than five undergraduates (Table 2). We also found that more than 56.6 percent of the mentors were involved in the program because they "wanted to give back," and none reported that the scholarship was the incentive. Fully 73.3 percent of the graduate students reported that improvement of their mentoring skills through this program was the primary benefit. This is an important result. Only one responding mentor reported "no real benefit" to the program.

Mentors' views on the most negative aspect of the program were a bit more varied, but difficulties in gauging the students' knowledge was cited the most frequently, followed by "stress of the added responsibility" and "balancing needs of self and mentee." None of the graduate mentors reported that the training they received prior to the apprenticeship program was not useful. Indeed, 73.2 percent agreed or strongly agreed that it helped prepare them to mentor their apprentice. Further, 30 percent of the graduate students indicated they found the "planning activities" section of the training to be the most helpful.

Table 2. Graduate Mentors' Survey Responses, 2013 and 2014 (n=30).

Survey Questions and Response Options	%
How many years in graduate school have you completed?	
1	10
2	26.7
3	23.3
4	16.7
5 or more	20
No Answer	3.3
How many undergraduates have you mentored through research not including your LEARN student(s)?	
This was my first mentee(s)	33.3
1-2	16.7
3-4	26.7
5 or more	23.3
What was your main motivation for mentoring an undergraduate through the LEARN program?	
Expand resume	20
Needed help on my project	3.33
Wanted to give back	56.6
Faculty mentor encouraged me	10
Scholarship	0
Other	10
What best describes your primary benefit from mentoring with the LEARN program?	
Improved my communication skills	13.3
Improved my mentoring skills	73.3
Expanded my resume	3.3
Provided help on my project	0
No real benefit	3.3
Other	6.7
What was the most negative aspect or difficulty of the mentoring experience for you as a mentor?	
Reduced research productivity	13.3
Gauging mentee's knowledge and abilities	26.6
Stress of added responsibility	20
Balancing needs of self and the mentee (i.e., time, schedule, direction, etc.)	20

Conclusions and Next Steps

Very little research has been done to explore the role graduate students can play in facilitating a successful research experience for undergraduates or the benefits for both parties (Bickel and Schneider 2013; Horowitz and Christopher 2013; Dooley, Mahon, and Oshiro 2004; Carsrud 1984). The work presented here showcases the benefits to the graduate students (Table 2) and defines the twelve-week apprenticeship as relevant exposure to the research world (Table 1).

It appears that both undergraduates and graduates are benefiting from the LEARN program. Our review, although limited to a small target population, showcases the important role graduate students can play in undergraduate research. The graduate students have been successful in exposing first-year students to a wide variety of research activities. As Table 1 indicates, in just 36 hours over 12 weeks, the students have experienced numerous components of a research environment and the research process.

Although the current model is used for STEM students, this short apprenticeship model can be adapted to non-STEM majors. Graduate students in different disciplines could meet their mentees in libraries, studios, or other research sites. Instead of a graduate student, upper-level advanced undergraduates could be the formal mentors of first-year students if space and resources are available. In fact, to date, two of our mentors have been advanced undergraduates who came strongly recommended by a faculty member on campus. With training and guidance, programs such as LEARN can be a valuable experience for the mentors and mentees.

Several lessons have been learned from developing this program. The longer the program runs, the stronger it becomes. Each year the mentoring training has been strengthened with information learned the previous year (Bickel and Schneider 2013). The training of mentors occurs in one day since graduate students often must balance research, coursework, and a teaching assistantship. However, it would likely be beneficial to continue training and meeting with mentors throughout the duration of the apprenticeships. New mentors benefit from details on what other mentors have done, including what has worked and hasn't worked.

Additional research is under way to examine the apprenticeship program and the graduate mentors' experience in more detail. One project is having the graduate research mentors fill out activity logs independently of the LEARN participants, to allow us to determine if the mentors' documentation of student activity matches that of their apprentices. We also are planning a focus group with graduate mentors. Focus groups and additional meetings between program staff and mentors could better assist in understanding the experience the graduate mentors are having and expand the information generated from the current survey tool.

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Using *COEUR* to Assess the Undergraduate Research Environment: A Three-Stage Model for Institutional Assessment

Outcomes assessment has become an increasingly important aspect of higher education in the past decade (Dehn 2010; Gardiner 2005; Lizzio, Wilson and Simons 2002; Lopatto 2008; Nilsen 2010; Spencer and Schmelkin 2002; Trosset, Lopatto, and Elgin 2008; Wehlburg 2006; Wulff et al. 2005). Although a major source of this impetus is to demonstrate accountability to external constituencies (e.g., accrediting agencies, funding agencies, state legislatures), outcomes assessment also can provide information to assist faculty members in recognizing what is working well in their education programs and what needs to be improved to support high-quality student learning (Fink 2003, Wehlburg 2006). The first challenge is to identify the appropriate outcomes, which has proven to be a major obstacle in assessing undergraduate research.

In 2012, the Council for Undergraduate Research (CUR) published *Characteristics of Excellence in Undergraduate Research (COEUR)* (Rowlett, Blockus, and Larson 2012). *COEUR* is not a list of learning outcomes, but it does provide a very good starting point for deriving them. *COEUR* was developed over a two-year period through a very strong participative effort of the CUR Council and the CUR membership. The document is organized into 12 principles that contain 64 characteristics. Each of these can be further broken down into assessable outcomes. In this article we describe the application of *COEUR* to the assessment of the undergraduate-research environment at Westminster College. The focus is on a three-stage model of assessment, rather than the results for the institution, because the methods used are broadly relevant for assessing the undergraduate-research environment.

The foundation of the three-stage model of assessing undergraduate research is the assessment map. To develop the map, we broke the *COEUR* characteristics down into their constituent parts so that each part referred to one outcome. This resulted in a set of independent and mutually exclusive outcomes. Each of the outcomes was then assigned to specific institutional constituencies (e.g., faculty, students, administrators), and methods of assessment were assigned to measure each outcome to create the map. For Westminster, the relevant constituencies were the college administration, select faculty committees, the undergraduate research director and council, department chairs, faculty members, and students as shown in Figure 1.

In the three-stage model of assessment, the assessment method varies according to the desired outcome. The assess-

Figure 1. Three-stage Model for Institutional Assessment of Undergraduate Research*

COEUR **Outcome**	Administration	CR Office		Faculty	Students
Campus Mission and Culture	X	X		X	X
Administrative Support	X	X		X	
Research Infrastructure	X	X			
Professional Development Opportunities	X	X		X	
Recognition	X	X		X	X
External Funding	X	X		X	X
Dissemination		X		X	X
Student-Centered Issues				X	X
Curriculum				X	X
Research-Supportive Teaching Calendar	X			X	
Assessment of Student Learning				X	X
Strategic PLaning	X	X			

*The model is rooted in a *COEUR* outcomes assessment map that links campus constituencies and research methods to each outcome. Figure 1 shows that the administration provides much assessment information through institutional audits and qualitative interviews, faculty provide focus-group and survey data, and students provide survey data.

ment methods used included an institutional audit, qualitative research (individual interviews and focus groups), and quantitative surveys. Each method is most appropriate at a specific stage of the assessment. An institutional audit of existing data can inform qualitative interviews, which then provide a firm basis for quantitative surveys. Each method will be described below with examples of the types of outcomes and some of the findings. Allocation of specific outcomes to particular campus constituencies, as described in the assessment map, was reviewed by three faculty members who were also CUR Councilors and the institution's vice president for academic affairs before any assessment data were collected. A portion of the concept map is shown in Figure 2.

Figure 2. Simplified Sample Assessment Map Identifies Constituencies Assessed to Measure Each Outcome*

COEUR **Outcome**	Admin	UR Office	Committee	Chairs	Faculty
Faculty compensation	Audit Interview		Focus Group	Survey	Survey
Campus Mission and Culture	Interview	Interview	Focus Group		
Research Infrastructure	Audit	Interview		Survey	Survey
Professional Development	Audit		Focus Group	Survey	
Recognition		Interview	Focus Group	Survey	Survey
Curriculum				Survey	Survey
Strategic Planning	Audit Interview	Interview			

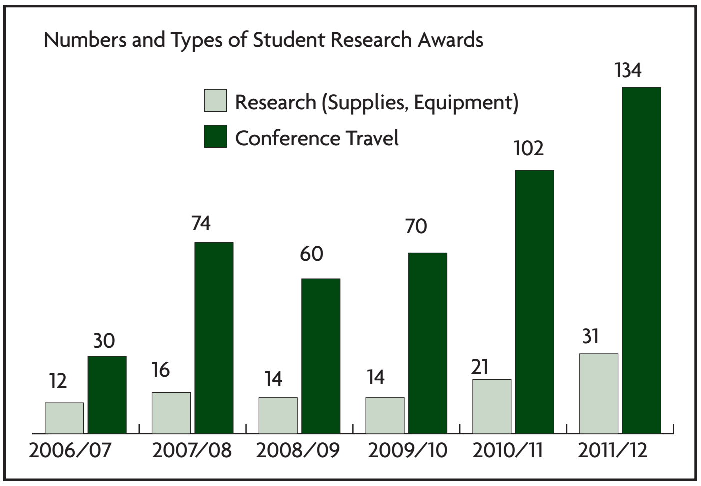
*The complete concept map is available in the online supplement in *CURQ on the Web*.

Institutional Audit

Some outcomes can be directly assessed by using existing institutional data. For example, the first characteristic of *COEUR* involves the campus mission and culture. The first component of this characteristic, campus commitment and culture, can be broken down into several assessable outcomes. One of them, clear statements of alignment of undergraduate research with the college's mission statement and the strategic plan, can be assessed by examining those college documents, which are public. In our case the college mission statement did not directly address undergraduate research. On the other hand, the strategic plan placed undergraduate research in the context of experiential learning and specifically targeted resources for it, such as "Enhance the Drinko Center as a major institutional resource to coordinate and financially support experiential education, student research, community outreach, and faculty development." An institution's public documents offer a rich source of assessment data, especially because they can be corroborated by other measures such as faculty and student perceptions.

Valuable institutional audit data came directly from the undergraduate-research office. It has statistics on student participation in undergraduate research using funded research grants and on student presentations at external venues and at the annual Westminster Undergraduate Research and Arts Celebration. These data can be used to address many of the more than 200 assessable outcomes (as shown in the online supplement in *CURQ on the Web*). Additional institutional data can come from faculty-development sources (such as faculty-development officers, the associate dean, or the faculty-development committee) that have tracked faculty-student collaborations for professional presentations and publications. Figure 3 shows the number of student research and travel awards since the beginning of the Drinko Center for Experiential Learning. These data support the *COEUR* characteristic of dissemination of research, and specifically the subcomponents dealing with student presentations at professional meetings and at student research conferences.

Figure 3. Growth of Institutional Support for Undergraduate Research Through Undergraduate Research and Travel Awards Program



Qualitative Research

The institutional audit can show how many individuals participate in funded undergraduate research, and how much funding has been applied to that research. However, it cannot show how adequate that support is perceived to be by the key constituencies. Qualitative research is needed to show how specific aspects of undergraduate research are valued, how they integrate with the entire educational enterprise, and how the culture of undergraduate research is developed. Our qualitative research took two forms. The first was in-depth personal interviews with top administrators and key leaders in undergraduate research at Westminster. These included the president, the vice president for academic affairs, and the head librarian. The second type of qualitative research was focus-group discussions with committees and groups of faculty members, including the faculty-development committee, the current and former directors of undergraduate research and the center for experiential learning, and the undergraduate-research advisory council.

The research method for the structured interviews began with the construction of an interview outline based on the areas of *COEUR* identified in the assessment map as pertaining to the individual's institutional role. For example, the president was interviewed about the elements of *COEUR* related to mission, strategic planning, and resource allocation. Figure 4 shows the outline used in the interview with the president, with the *COEUR* outcomes numbered to align with the assessment map. The interview outline was provided to the respondent before the interview. It served as a guide for the discussion, but it did not preclude discussion of new issues arising during the conversation. The interview was conducted by one member of our research team who was trained in interview techniques, while other members of the team took notes. The notes were used to fashion a narrative that represented the gist of the conversation. It was sent to everyone who attended the interview to ensure that the record was essentially correct. The common practice of tape recording interviews was not used because voice recordings tend to constrain conversations, especially in communities in which individuals are well known to each other.

In all interviews it is important to have an open opportunity to find new information that was not suggested by the interview outline. For example, after discussing undergraduate research characteristics related to *COEUR,* the president ended the conversation by posing his own question. He asked how we could measure the value added from undergraduate research in the overall education of an undergraduate.

The major findings from the qualitative interviews were that all campus leaders interviewed value undergraduate research,

Figure 4. Sample Outline for a Qualitative Interview Regarding *COEUR* *****

COEUR Interview Questions for the President
1.0 What is the definition of undergraduate research at Westminster?
1.1 Institutional commitment
    How does Westminster show commitment to undergraduate research?
    How does undergraduate research feature in the strategic plan?
2.7 Research Grants Office
    How does institutional advancement support undergraduate research?
    Westminster does not have a research grants officer. Why not?
    Westminster does not have an institutional research integrity compliance officer. Why not?
6.0 External funding
    What is the current role of external funding for undergraduate research?
9.1.3 Course scheduling and managing faculty teaching loads
    How are teaching loads determined to support undergraduate research?
12. Strategic Planning
    What are our benchmarks and strategic plans relative to UR?
From the president's perspective, what other role does the president play with in regards to undergraduate research?

*The numbers on the interview points correspond to the relevant *COEUR* assessment outcomes.

even if they have differing definitions of it and different reasons for valuing it. Top administrators see undergraduate research as demonstrable student engagement in experiential learning. They also see it as a high-impact practice that can lead to high visibility for the college, but also as a practice requiring high institutional expenditures in terms of faculty time and resources. Members of faculty committees and those who lead undergraduate research at the institution see undergraduate research as primarily an opportunity to improve student learning by engaging students in doing the scholarship of the various disciplines. Even the current and former members of the faculty-development committee did not see undergraduate research as primarily a means to keep faculty members engaged in research at a teaching-intensive college. Finally, the qualitative research produced a list of potential barriers and opportunities for undergraduate research, to be studied in the quantitative research.

Quantitative Research

Focus groups and individual interviews provide in-depth perspectives on the outcomes that undergraduate research may produce. Examples, processes, and motivations can be made clear. However, they represent only the views of those people interviewed, who have been selected due to their leadership roles. Surveys provide more representative data for the other key constituencies: the faculty in general and the students. Although the faculty and administration are the driving forces behind undergraduate research, it was important to also understand how they perceive undergraduate research and why they seek to conduct it.

Our surveys focused on faculty and student perceptions of the outcomes that are best assessed at the level of those people directly involved in undergraduate research. Based on the qualitative research, we knew that we needed to begin with the definition of undergraduate research. CUR defines undergraduate research as "an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline. Undergraduate research—a term that encompasses scholarship and creative activity…" (Rowlett, Blockus, and Larson 2012). However, many faculty members and students perceive undergraduate research to be something else. Therefore, we began by asking people whether they agreed with a variety of definitions of undergraduate research that had arisen from prior qualitative research. Next we asked respondents to describe their degree of involvement with undergraduate research. The remainder of the survey focused on specific characteristics of undergraduate research listed in *COEUR,* such as faculty supervision (teaching load, tenure and promotion credit), perceived barriers to undergraduate research (role in the curriculum, student course credit, resources), and perceived resources to support undergraduate research (faculty development, external organizations, funding, faculty encouragement, technology, etc.).

Two undergraduate researchers created separate online surveys devoted to these specific items from a faculty and student perspective. Faculty surveys consisted of 15 questions, while student surveys consisted of 19 questions. Our experience in previous online surveys was that students will answer more questions than faculty members will. The anonymous surveys were administered through email links to all faculty members and to all full-time students. Three requests to participate in the survey were sent during a two-week period in November 2013. At the end of the survey, participants could request a summary of the survey results and sign up for an opportunity to win a prize ($25 food/gas voucher for students or a pie for faculty members) by completing a second brief survey.

Survey Demographics

Faculty sample. About three quarters of the full-time faculty members began the survey. Sixty-one faculty members (59 percent) completed the demographic items at the end of the survey. The faculty members who completed the survey were representative of the faculty in terms of gender. Associate professors were most likely to complete the survey (75 percent), and lecturers were least likely (25 percent). About half of assistant and full professors completed the surveys.

Student sample. There were a total of 248 completed student surveys. These represented 19 percent of the full-time undergraduates enrolled in a degree program during the fall 2013 semester. Only the junior class was represented in the sample in the same proportion as it accounted for in the college (19 percent). First- and second-year students were underrepresented among respondents with 15 percent of those classes completing the survey, and seniors were overrepresented because 29 percent responded to the survey but seniors only make up 26 percent of the student body. Overrepresentation of the seniors is good because seniors know more about the programs of the college and are likely to have more accurate perceptions of undergraduate research. They make up two fifths of the sample. As in most student surveys, women were more likely to complete the survey, with 24 percent of the Westminster female students included in the sample, compared to 10 percent of the Westminster male students. The sample is probably biased in favor of students who are, in fact, engaged in undergraduate research.

Table 1. Student and Faculty Agreement with Various Definitions of Undergraduate Research

Definition	Students % n=248	Faculty % n=61
Students pose their own original questions and use the scholarly methods of the disciplines to answer those questions.	89	94
Students collaborate with faculty members on research teams.	82	93
Students produce original intellectual products such as performances, visual arts, or music.	33	75
Students participate in research to provide data for others.	61	51
Students write papers based on library work.	76	50
Students act as assistants on other students' research.	71	35

Survey Findings

The majority of the faculty members surveyed subscribed to CUR's definition of undergraduate research, as shown in Table 1. Students, however, tended to perceive more things as undergraduate research, including any forms of study. But they often did not view as undergraduate research or creative activity the production of intellectual products such as performances, visual art, or music. We did not ask faculty members whether studying for a final exam was undergraduate research but, of the students surveyed, half of the first-year class and half of the juniors selected this as a form of undergraduate research. Only 29 percent of the sophomores in the sample and 23 percent of the seniors selected this option. Faculty members are less likely than students to perceive students assisting other students on research projects as being engaged in undergraduate research. For faculty members, the quality of the intellectual product and faculty supervision seem to be key to accepting an activity as undergraduate research. For students, actual activity on anything related to traditional research areas seems to qualify as undergraduate research. It is important to recognize that when students and faculty members speak of undergraduate research, they may be thinking of many different activities and do not have one clear conception of what activities constitute UR.

When presented with CUR's definition of undergraduate research and asked, "How often do you incorporate undergraduate research projects into your classes?" 52 percent of faculty respondents said they did so every semester, while 18 percent answered every year, and 11 percent said that they did so most academic years. Thus 80 percent of the faculty reported regularly engaging in supervision of undergraduate research. This is consistent with Westminster's capstone curriculum, which requires students to engage in experiential disciplinary projects, which for most majors means undergraduate research theses. Forty-two percent of the faculty members reported that they received no teaching-load credit for supervising undergraduate research, yet only one quarter supported that situation. When asked for the ideal number of credit hours for supervising undergraduate research, the majority of faculty members said between two semester hours and eight semester hours (75 percent of the sample). Of the 63 faculty members who answered both questions about the actual and ideal load, 29 percent reported that they were receiving the ideal amount of teaching-load credit for supervising undergraduate research. The remainder reported receiving no teaching-load credit or a less-than-ideal amount of credit.

Students were given the definition of undergraduate research agreed upon by the Westminster Undergraduate Research Advisory Council: "Undergraduate research can be defined as when students pose their own research questions and use the methods of their majors to solve those questions. It can include original creative/artistic productions, historical/literary analysis and/or a collection of new data to answer those questions. Please use this definition as you answer the following questions…"

When asked if they had participated in such activities, 68 percent answered yes and of that percentage, 78 percent reported they had completed two or more research projects. However, the most frequent first research experience checked was the first-year program (39 percent), followed by a research-based course (24 percent) and a capstone project (23 percent). Undergraduate research as a concept is introduced in the required first-year course through faculty panels that present the scholarship of various disciplines and a research prize is awarded to a first-year student for a research-poster presentation at the Undergraduate Research and Arts Celebration in April of each year. The existence of the prize is communicated to students during their first semester, but few students participated in the first-year research competition. Yet according to the survey, more than a third of the students consider their first-year program research to be their initial foray into undergraduate research. Participation in undergraduate research increased from the first year (when 43 percent of that year's class reported engaging in it) to the senior year, when 85 percent of seniors reported doing so. Most students appear to be engaged in undergraduate research by the first semester of the senior year.

Barriers To, Resources For Undergraduate Research

While most of the barriers to undergraduate research are different for faculty and students, the main barrier is the same for both. Time was cited as a barrier by 78 percent of the students and 77 percent of the faculty members. Faculty members said that money (45 percent) and student abilities (44 percent) were barriers to undergraduate research. While the other obstacles listed were not significant barriers to research for most faculty members, they may prevent engagement with undergraduate research for some faculty. These barriers include library resources, technology, equipment, space, and priority for tenure and promotion. Some students also listed barriers in addition to time, including money (21 percent), equipment (12 percent), and lack of encouragement from professors (12 percent).

The surveys also included items concerning available resources to support undergraduate research. Students agreed strongly that they had access to resources through the library, technology, and departments. Faculty members rated the annual undergraduate research and arts celebration, their departmental colleagues, and discipline-specific organizations as the most beneficial resources for undergraduate research.

Assessing a Moving Target

Action research, as all assessment research, is likely to produce outcomes as it measures those outcomes. This three-stage assessment (institutional audit, qualitative research, quantitative surveys) was accompanied by changes in undergraduate research on campus even as it was being conducted. It is impossible to single out the causes of these changes, although it is clear that assessment of undergraduate research through interviews and surveys led people to begin to think more deeply, and perhaps in different ways, about engaging students in undergraduate scholarly and creative endeavors.

One example of these changes was curricular revisions that more explicitly focus on undergraduate research and outcomes assessment of undergraduate research. The psychology department moved from the previous 12-point American Psychological Association guidelines for the undergraduate major to the new version 2.0 (American Psychological Association 2013), which includes only five categories (as shown in Table 2). But the new version has made undergraduate research more prominent. As a result, the psychology faculty assessed their curriculum with respect to how each course addressed the specific guideline of communicating scientific knowledge. Many assessments incorporated as a desired outcome through undergraduate research integrated into the curriculum. For example, learning to write a research report and present research are begun at the foundational level in the sophomore research-methods course. These skills are extended and strengthened during the junior-level laboratory courses, and ultimately expressed through senior-level capstone research presented and disseminated at undergraduate and professional research conferences.

Table 2. Learning Goals for Baccalaureate Degrees in Psychology

Learning Goals: APA Guidelines for the Undergraduate Psychology Major, Version 2.0
Goal 1: Knowledge Base in Psychology
Goal 2: Scientific Inquiry and Critical Thinking
Goal 3: Ethical and Social Responsibility in a Diverse World
Goal 4: Communication
Goal 5: Professional Development

The full document describing each goal, its sub-goals, and foundational and baccalaureate outcomes can be found at www.apa.org/ed/precollege/about/psymajor-guidelines.pdf.

A second change that took place during the assessment involved the role of undergraduate-research mentoring and student/faculty collaborative research in faculty tenure and promotion considerations. After the presentation of the initial qualitative research at the faculty forum that also introduced *COEUR,* the role of undergraduate research in faculty tenure and promotion reviews became a major point of controversy for the faculty. There were two main points of contention. Some disagreement sprang from the different ways in which faculty members defined undergraduate research. These ranged from defining all independent work done by students (e.g., term papers) as undergraduate research to other perspectives that defined as UR only student/faculty collaborative research that resulted in new knowledge that could be disseminated through the scholarly outlets of a particular discipline. These differences were highlighted in the results of the faculty survey.

The second point of contention was that if supervising or collaborating with students on undergraduate research became a consideration for tenure and promotion, it would soon become a de facto requirement for all faculty members, rather than a voluntary opportunity for some. As the debate continued, the college devoted a faculty workshop to development of discipline-related guidelines for faculty scholarship appropriate for tenure and promotion review. These guidelines explicitly addressed the role of undergraduate-research supervision/collaboration in the review process as related to teaching, service, and scholarship, the three categories of faculty work considered in such reviews.

A third preliminary outcome of the assessment was that many students were unsure of whether their research qualified for presentation at the Undergraduate Research and Arts Celebration (URAC) on campus. A special workshop was offered on if, and how, to apply for URAC in order to counter student attitudes that research was only for some disciplines and only for seniors in those disciplines. The first workshop was held in the spring semester before URAC proposals were due. The majority of the students who came were senior humanities majors who did not know if their scholarship was suitable; nor did they know how to write an abstract to describe it. A second workshop offered during the next fall semester attracted students from a more diverse range of disciplines and also included some first-year students.

Practical Logistics of Institutional Assessment

Institutional assessment of undergraduate research must be tailored to the academic structure of the institution. In this case, given a small liberal arts college with a history of faculty leadership in the development of a research-inclusive curriculum, faculty members were the prime movers in formulating and carrying out the assessment. The survey research in the third phase was conducted with faculty and student collaboration. Our three-phase program of assessment took place over two academic years and was conducted by three faculty members and two undergraduates. The bulk of the work was done by the two authors of this article. Three Westminster faculty members who also are CUR councilors began to brainstorm about the assessment on the way back to campus from the CUR Biennial Conference 2012 at which *COEUR* was unveiled. Author Webster broke the *COEUR* characteristics down into assessment outcomes and asked the other CUR councilors to review them. She then developed the assessment map in consultation with the vice president for academic affairs and the director of the Center for Experiential Learning.

The institutional audit and qualitative assessments occurred during the spring semester 2013 when Webster requested and received information from the academic dean, director of institutional research, and the director of the Center for Experiential Learning. Webster and the other CUR councilors conducted personal interviews with the president, vice president of academic affairs, the head librarian, and the undergraduate research directors (past and present). They also conducted a group interview with members of the past and current faculty-development committees.

The faculty survey was constructed in the following fall semester by Webster. The second author, Karpinsky, a senior psychology major at the time, developed the student survey. She based it on the faculty survey but tweaked it to make it appropriate for obtaining student perspectives. Both quantitative surveys were administered by Karpinsky, who also did the preliminary statistical analyses. Reports of the research results were prepared for all constituencies during the 2014 spring semester and included brief summaries for participants in the faculty and student surveys; a written report for the director of undergraduate research; and a formal presentation to the faculty.

Conclusions

Using the outcomes derived from *COEUR* allowed us to complete a comprehensive assessment of the undergraduate-research environment at the institution that can help shape future developments in undergraduate research. Administrators, faculty, and students have different perspectives on what constitutes excellence in UR. In general, administrators want strong programs that enhance the reputation of the institution and bring in more students. Faculty members seem to be focused most on how to educate students well and prepare them for the future. They engage in scholarship because that is their identity and calling. They invite students to collaborate in that scholarship so that students can better learn the methods of the discipline while also producing new knowledge. Students see undergraduate research as a very rich learning experience that will give them the tools that they need to pursue careers after graduation. They see it as a way to work closely with faculty mentors and to learn the newest, most exciting aspects of their majors.

There are additional ways to divide the constituents of undergraduate research. Surprisingly, the differences within gender, rank, and disciplinary groups are stronger than those between them. This was particularly striking in the survey data. For most questions the range of differences within the sample was much larger than differences between sample segments (e.g., discipline, class rank/faculty rank, gender). By and large, students (especially seniors) showed attitudes and perceptions about undergraduate research similar to those of faculty members. This means that even though the survey did find evidence of a strong culture of support for undergraduate research, different individuals perceive it very differently even within the same disciplinary silos.

A final conclusion from this assessment is that time is the biggest barrier to undergraduate research for both faculty and students. While each of the other barriers assessed was cited as insurmountable by some respondents and not relevant for most, time was a barrier across the board. This suggests that curricular and institutional restructuring efforts must recognize the high value and impact of undergraduate research and make sure that time for faculty members and students to do it well is incorporated into new initiatives.

Next Steps

This assessment has focused on the current environment for undergraduate research at Westminster College through gathering administrative, faculty, and student perceptions of its value and potential. The next step of the assessment is to measure the impact of undergraduate research on students after they have graduated. Post-graduation assessment also must follow the three-stage approach, as well as the multiple-sample approach. This is because the institution has a record of alumni accomplishments (audit), and many alumni have stories of how undergraduate research has influenced their careers (interview), but only a survey can show the extent of that impact. Undergraduate research is a high-impact practice that results in high student and faculty engagement and does lead to the production of new knowledge. The question of how much value it actually adds to the education of the undergraduates, and to the long-term production of new intellectual products (scientific results, musical compositions, sculpture, drama, literary criticism, and so forth) requires assessment of post-graduation outcomes. This assessment can also benefit from *COEUR*. The characteristics of excellence in undergraduate research have clear applications to many assessable post-graduation outcomes. *COEUR* can supply the starting point for deriving a multi-method, multi-constituent assessment map.

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Integrating Research and Education: Undergraduate Field Work in Geography

As part of a five-year award from the National Science Foundation's Faculty Early Career Development (CAREER) program, five undergraduate students and a principal investigator, author Cheong, participated in two weeks of fieldwork in coastal Louisiana in January of 2014. The objective of the fieldwork was to integrate the PI's individual research with the students' education. With the goal of improving students' research experience, this article analyzes their experience of the fieldwork using the results of student surveys and interviews. We focus on the findings that students were simultaneously interested in continuing with research while also being frustrated and stressed. Emphasizing students' own understanding of their research experience, we provide insights into the paradox of an undergraduate research experience that can be both difficult and inspiring. We believe the results can contribute to new ways of thinking about undergraduate research.

Fieldwork in Geography

Unlike undergraduate research based in the laboratory or at field stations, research in human geography often entails societal interactions outside the confines of a regulated environment. Research methods, including participant observation and interviewing, force researchers to engage with people in society. Researchers' social skills and cultural sensitivity become important as a result. These skills take time to build, and classroom education is not sufficient to provide them. In this light, fieldwork offers a venue for students to develop these skills through firsthand experience.

Geography has a long history of educating its students through immersive field research. Geographers value experiential learning in the field as part of the disciplinary tradition. Such experiential learning engages all the senses, intellect, and emotions, leading to a holistic understanding of the field (Crothers 1987). Geographical studies, from traditional discovery and exploration to contemporary hypothesis testing and theory, elucidate spatial inquiry by making use of field data that link global and local processes.

University fieldwork is often conducted as part of a degree or research program. This process requires extensive preparation, debriefing, and the explicit integration of fieldwork into a course so that students learn and retain skills over time (Kent et al. 1997). Students' experience levels need to be considered and accommodated as students should be adequately prepared to participate in fieldwork. A high degree of student autonomy is also beneficial. Although fieldwork promotes student-centered strategies, a balance between research objectives and student education is important because it leads to reciprocal learning (Kent et al. 1997).

The benefits of fieldwork are several. Students learn to work with others and develop social skills through group dynamics. Fieldwork can also lead to increased student confidence, motivation, and better overall performance (Seymour et al. 2004). Furthermore, direct student involvement in research encourages inquiry-based learning (Healey 2005) as the instructor plays the role of a facilitator instead of a lecturer (Elton 2001). Such involvement generates learning that is more meaningful and deeper than that of the classroom (Healey 2005).

Despite the benefits of fieldwork, preparation of students, liability issues, and logistics all can be challenging. For students, adjusting to a dramatic shift from the classroom to the field can be difficult. Some students may feel anxious prior to fieldwork because they may not be able to imagine their field experience. Bishop (2009) notes "culture shock" in the field. He describes a progression in student attitudes that begins with exhilaration at the prospect of a new experience. Once at the research site, the experience is inevitably different than the students imagined it would be, which can be a harsh realization. Adjusting through this transition and learning to surrender are challenging as students fear being out of control in a new and stressful situation. Personality clashes and perceived work overload in the field can also be hindrances to successful field research (Sproken-Smith et al. 2008).

Fieldwork Description

Learning outcomes: One goal of this NSF CAREER project is to integrate research and education. The overall objective of the project is to investigate how coastal communities in Louisiana adapted after the Deepwater Horizon oil spill in 2010, focusing on communities' dependence, community ties, and the ways the communities receive and use resources and information. The educational objective is to provide students with research experience and to promote student-society interactions. The exchange of knowledge between students and local stakeholders offers a valuable experience of the "other" for both sides, and also increases the capacity for cultural understanding crucial for research collaborations now and later in students' careers. Students can learn and practice research methods and leadership skills by being responsible for a specific aspect of the project and by learning to coordinate and collaborate with others.

Type of fieldwork: Unlike typical field courses or undergraduate research programs with large-scale institutional support and funding, this fieldwork was part of an individual research project supported by a single PI's grant. Therefore, the number of students who could be engaged was limited to five undergraduates. Fieldwork was scheduled for winter, allowing students to prepare in the fall and write up their results in the spring.

Recruitment: Interested students were asked to take the fall class and prepare for fieldwork. The instructor, with the assistance from the university's Center for Undergraduate Research, solicited applications campus-wide in October of 2013. After interviews with applicants, five students, including the two from the fall class, were selected. The five were all then required to take the spring course in order to analyze the results of the fieldwork and write a term paper.

Student characteristics: The winter fieldwork participants were all female natives of the state. Four students were environmental studies majors (one was a double major in Spanish) and one student was majoring in East Asian languages and culture. There were no applicants from geography. The five were a mix of sophomores, juniors, and seniors. All students' had cumulative grade point averages above 3.0. Two of the five students had some lab experience but none of them had conducted fieldwork prior to this trip.

Training/preparation: Two of the five students took the fall class that offered training. All the participating students took a four-hour workshop at the end of November 2013. The workshop included student presentations on prior assigned readings, details about research themes, an outline of duties in the field, and travel plans. From early December to early January, the instructor generated a set of student assignments with deadlines. Assignments included individualized travel plans detailing their responsibilities in the field, required readings, a reading list, and interview scheduling. Students contacted people of different groups ranging from fishermen, representatives of non-governmental organizations, local government officials, and tourism and oil workers. To set up interviews prior to the trip, they filled out an interview worksheet, and they were asked to consider travel distances between interviews. Students generated a Google calendar on their own to schedule these appointments so they would not conflict.

Logistics: Fieldwork was based in two different locations. The first week of fieldwork was on a small barrier island; it took ten minutes to drive anywhere on the island. The second location was in a facility designed to conduct marine-science field research. From this location, it took from twenty minutes to an hour by car to reach interviewees. Students were paired for interviews, and they were divided into two groups with two designated drivers. All the students conducted and transcribed interviews. A student leader alternated every other day. Her duties included coordinating schedules, contacting people for on-site interviews, and being the central point of contact for the students and the instructor. The leader also operated as a scribe, writing the minutes of the team meeting held every evening.

Methods

Student surveys were built into the project's design to document students' fieldwork experiences. Although the initial focus was on student-learning outcomes, the KU Center for Teaching Excellence and the instructor decided to extend the assessment to student affective outcomes after observing some discrepancy between student learning and student satisfaction.

The surveys were adapted from the SURE Preflection Survey (Lopatto 2004) to explore students' self-identified education/career plans, academic skills, interviewing skills, thoughts on diversity, and teamwork. All five students completed online surveys before and after the fieldwork. A total of forty-four multiple choice questions were analyzed in the two surveys. Students were asked to rate their agreement with each statement, based on a Likert scale from one to five, 1 representing "strongly disagree" and 5 "strongly agree." This enables researchers to calculate a mean "agreement response" for each statement. The surveys each contained three identical open-ended questions. The preflection survey also contained four open-ended questions asking students to imagine interview scenarios. The survey after the fieldwork contained two open-ended questions designed to identify students' perceptions of their improvement in academic and personal skills through participating in the fieldwork.

To expand the scope of the assessment to the affective domain, an exit interview was conducted two months after the fieldwork. The exit interview focused on students' experience in the field and students' relationships with each other and with the instructor. Each interview lasted approximately twenty-five minutes and was conducted by a staff member of the KU Center for Teaching Excellence, acting as a neutral third party. All personally identifiable information was removed before the transcripts of the interviews were shared with the instructor. Qualitative analysis was used to examine interview texts.

Results of the Two Surveys

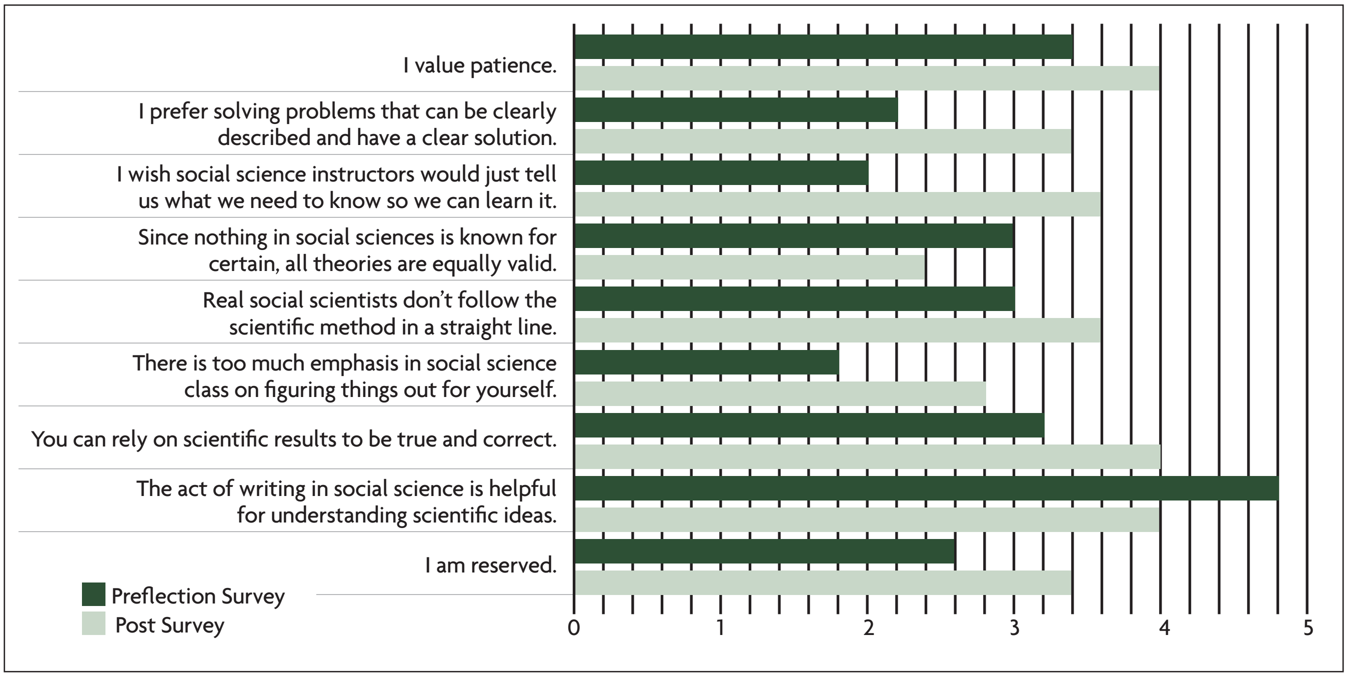
Comparisons were made between students' assessments of their skills before and after the fieldwork. Skills in mathematics received the lowest scores, with public speaking a close second. All students said they were planning to attend graduate school in both surveys. Students reported that they valued patience more after the fieldwork and felt more reserved. They demonstrated perseverance in learning and introspection. Their frustrations with fieldwork can be seen in their increased agreement with certain statements posed in the survey (Figure 1): "I prefer solving problems that can be clearly described and have a clear solution," and "I wish social science instructors would just tell us what we need to know so we can learn it."

After the fieldwork, optimism is expressed in the students' increased agreement with the statement: "You can rely on scientific results to be true and correct." An improved understanding of social science methods is also reflected in the students' increased agreement with the statement that "Real social scientists don't follow the scientific method in a straight line," and decreased agreement with the statement that "Since nothing in social science is known for certain, all theories are equally valid." The findings indicate that student learning incorporates multiple perspectives and context-dependent interpretations of social science theories and phenomena.

Regarding responses to the open-ended questions, one student wrote that delving into the social, rather than physical, sciences had been eye opening and took her out of her comfort zone. Improved efficiency and quick thinking were also skills attributed to the fieldwork experience. Several students said that they learned adaptability, improvisational skills, flexibility, and the art of compromise. When faced with scheduling dilemmas and other factors beyond their control, students were forced to learn to surrender to the moment. Relinquishing control, therefore, became a valuable life lesson. Through the variety of challenges they faced, they consistently felt that the benefits outweighed the struggles. Students felt they were "pushed" and that they personally benefited from dealing with trying circumstances.

With respect to their experience in conducting interviews, students said they had trouble communicating with interviewees. To overcome these issues, many students mentioned that learning to rephrase questions and tailoring communication for each situation were critically important for successful interviews. Each student mentioned the importance of communication, and several referred to their

Figure 1: Student Surveys Before and After the Fieldwork



skill improvement during the fieldwork. Another student mentioned that the biggest obstacle she perceived in fieldwork was the local dialect and that she found the best way to overcome it was simply to increase her experience in listening to the dialect.

Developing social skills and learning to work as a team were central themes that students cited in the survey conducted after the fieldwork. Students also expressed the desire for a coherent, agreed-upon activity plan to be in place before starting fieldwork. Issues such as unnecessary repetition of work, unavailability of team members, and equal division of labor were all cited in the survey after the fieldwork. One student mentioned that it would have been beneficial to figure out each other's strengths before beginning the work, so that the group could better execute the detailed work while utilizing each student's strength. It took time, they said, to adjust to each other's personalities and find a middle ground. Another student said that balancing her drive for perfection with her desire to work well with others was a struggle, but ultimately a valuable experience. Three students said that more preparatory work before going in the field was needed. For example, students learned that seemingly unimportant tasks, such as rephrasing questions in different ways beforehand, would have smoothed communication in the field. However, such lessons can rarely be learned in the classroom.

Interviews with Students After the Fieldwork

The interviews focused on students' personal experience, ranging from difficulty adjusting to the different pace of the work in the field to the uncertainty of dealing with uncharted intellectual terrain. Students' responses focused on the important themes of knowledge, independence, and pace.

Knowledge: None of the students majored in social science, human geography, or humanities, and the type of fieldwork they conducted was new for most of them. Students had to constantly act beyond their comfort zones and make adjustments in unfamiliar encounters. They said that the workload was quite different than the pace to which they were accustomed. Rather than leaving work at a lab or class, the work was continuous.

Only two students had taken the fall course that taught them how to do interviews prior to the fieldwork. For most participating students, asking strangers three to four key questions and then coming up with follow-up questions on their own was daunting. Aside from training, successful interviewing is also linked to personality traits. Three students, for instance, could easily go with the flow and generate questions on their own, while two needed a structured set of questions.

Students said they felt unprepared for the field, but could not articulate what would have helped them beforehand. Three said that they had ample preparation ahead of time, but that the sorts of challenges they faced were unpredictable. Students described feeling scared about obtaining the correct or an appropriate amount of information while interviewing. Being uncertain of what was expected from the interview data left them wishing for more guidelines to take to the field. Students acknowledged that the readings they had completed beforehand gave them some sense of how interviews worked, but they also stated that the actual experience was radically different from what they had imagined. Having set up contacts before arrival helped with the stress of the unknown, but did not take the uneasiness out of the actual experience once in the field. For the students, the stress of the process left them yearning for more structure.

Independence: Students said that they wanted the instructor's approval to such a degree that it made them nervous about their performance. When the instructor was present during students' interviews, the students said they felt very worried. While the instructor's goal was to take a secondary role and allow the students to speak, the students perceived her silence as an indication of a problem. The lack of immediate feedback during the interview was bothersome to them and left them wondering if they were going about the process correctly.

Students were sensitive to one-on-one instructor feedback and considered themselves to be singled out and criticized for wrongdoing. While students were eager for feedback on their performance, they felt that individual meetings with the instructor meant that there was misbehavior to correct. Students' idea of feedback was largely to get specific instructions on what to do during interviews and in the field. They found comfort in being told explicitly what role they should play. At the same time, they felt that their contributions or opinions were disregarded when the instructor gave evaluations and feedback on their performance. The uncertainty of how each student's work was adding to the collective research goal was also stressful for the students. Two students said they felt as if they needed a strong leader, rather than a level playing field of all.

Pace/flexibility: Students felt that it was not clear what they were supposed to be doing, and that the fieldwork was going in different directions. Changing leaders every other day was a major source of confusion as the leader was the main point of contact and coordination. This led to the perception that student roles and responsibilities changed frequently and that the change did not provide them with enough time to learn and improve. Students said that, while they understood that the goal was to give each student the opportunity to lead, in practice this process led to unnecessary confusion. One student declared she would have simply preferred to have one role for the entire trip, even if that meant losing out on learning other skills.

More than half of the fieldwork interviews were set up onsite through the snowball strategy. Students found it stressful dealing with this sort of flexibility on a daily basis. Students reported that they drove from one interview to another on short notice, made phone calls to schedule interviews on the run, and changed plans because people called to cancel or reschedule their interviews at the last minute. Students found this uncertainty unsettling. Interview scheduling was, therefore, a constantly evolving process and was frequently interjected into the day's schedule. The changes left little time for formal feedback on the interviews, which students craved.

The location of the research also made an impact on students' experience. They had to adapt quickly to various research settings. They felt stressed when they drove half an hour from one interview to another. In addition, the students felt that the flexibility of the research process extended to the research goal. The perception of a research goal in flux, combined with daily uncertainties, created more anxiety for the students.

The students' negative perceptions translated into criticism and some dissatisfaction with the instructor. Peer-group dynamics, on the other hand, were positive. Good teamwork was emphasized by the instructor from the beginning and led to a strong sense of camaraderie. Students enjoyed working together and relied on one another for support. They also liked being in new places, meeting new people, and being immersed in a different culture.

Reflections

Integral to the analysis outlined above is the importance of faculty mentoring (Pita et al. 2013). Unlike many cases of fieldwork, this one differed from other types of faculty-student engagement (Kardash 2000; Nagda et al. 1998) in that it involved immersive face-to-face interactions with faculty, students, and strangers continually for two weeks. The cultural differences among the faculty, students, and locals they interviewed combined with different levels of student experience and preparation generated unique challenges.

Motivation: Since none of the participating students were geography majors, their main motivations for participation were resume building and adventure seeking. Students were aware that field research was outside of their skill sets. They mentioned prior to the trip that the social science/geographic research and methods were not central to their academic interests. Consequently, students became more passive and considered this fieldwork to be a job or assignment. The desire to be led was stronger than if this field research were part of their major or degree requirements. Without a more appropriate academic background and deficiencies in training and preparation, this fieldwork was too challenging. At the same time, these students assessed themselves as high achievers and did not want to be perceived as failures. Once confronted with difficulties, frustration mounted, and blaming began.

Although mismatched goals and interests negatively affected students' motivation, student engagement increased as the fieldwork progressed. Students showed genuine interest in the plight of the affected communities and engaged deeply in the analysis of their interviews after the trip. This is indicative of inquiry-based learning often embodied in fieldwork and empathy derived from close contact with the society in question. The key is to be aware of these motivational factors and to draw them out during fieldwork with frequent discussions of students' encounters with people and their interpretations.

Preparation: There was not enough time to prepare three of the students for fieldwork, since they had not taken the preparatory class in the fall that two other students had taken. In addition, a two-week excursion to two different locations with more than fifty people to interview by two groups of students was a huge undertaking. It did not leave much time for elaboration and explanation of all the events that occurred during the fieldwork. As such, this undergraduate fieldwork operated under time constraints that prevented adequate training and effective communication.

Extensive preparation, debriefing, and explicit integration of fieldwork into a course are what Kent et al. (1997) emphasized as elements critical to improving the student research experience. To avoid "culture shock" in the field, discussed by Bishop (2009), and to facilitate students' adjustment from the classroom to field sites, "curricular scaffolding" can be useful. Providing intermediary steps in the transition to fieldwork can reduce the culture shock that students feel by offering them some sense of control and lowering their anxiety.

In this light, mentoring prior to fieldwork maximizes the instructor's opportunity to discover each student's abilities and to offer support. Also, behaviors that may pose a liability in the field can be recognized and addressed beforehand. One-on-one conversations can also help set performance goals for each student and provide criteria for student learning during fieldwork. A safe space in which the difficulties of fieldwork can be reflected upon is needed. These lessons add to the intellectual development of each member of the research team, but are accomplished best with considerable investment of time inside and outside of the classroom beforehand and during fieldwork. Funding, faculty availability, and departmental support are critical in providing suitable time for preparation.

Future goals: Hiring a postdoctoral associate or a mature graduate student to handle logistics and communication would be beneficial. Communication techniques in the field could be more developed as well. The size of the student group also becomes important if mentorship is to thrive. A ratio of two students to one instructor would be ideal instead of the five involved in this particular case. Most importantly, focusing on education instead of research while in the field would enhance students' fieldwork experience. That is, the proportion of time and effort dedicated to research and education cannot be equal. Much more weight on education than research is desirable and beneficial. This runs counter to the objective of integrating research and education so that both learning outcomes and research outcomes are equally valuable. With undergraduate research, however, focusing predominantly on the educational component may be one effective way to enrich students' fieldwork experience. This may be done best in an institutionalized program driven by the university and department with course requirements rather than through individual research projects. Finally, it may be prudent to make efforts to insure that the fieldwork experience is inclusive and recruits from all areas of the university. For some students, financial responsibilities, family life, or personal obligations, however, interfere with participation and make them less available.

Conclusion

Students' assessments of their fieldwork through surveys before and after fieldwork and exit interviews showed that the experience was both difficult and rewarding. Surveys noted improvements in students' assessment of their research and interviewing skills, attitudes, and interests in research, and in clarification of career and education goals. Students became more adaptable to new situations and change and came to appreciate and understand the issues communities faced after the oil spill. On the other hand, the frustrations, stress, and anxiety expressed in student interviews demonstrated the lack of adequate preparation and training prior to fieldwork, leading to heightened needs for support and assistance in the field. The pace and flexibility of field research in human geography were especially challenging, which was difficult to simulate in the classroom environment beforehand.

Research experience can always be challenging and stressful. At the same time, it is important to create as low-stress an environment as possible to allow undergraduates to reap the benefits of increased engagement with research. Careful preparation and faculty mentorship prior to fieldwork, a slower pace of research in the field, and an emphasis on education rather than research in the field can alleviate potential anxiety and stress. Students' experience can be further enhanced when field research is institutionalized and mainstreamed into coursework and engaged scholarship at both departmental and university levels. This can make the entire process of fieldwork, including preparation, systematic and inclusive of all students rather than a select few (Healey 2005).

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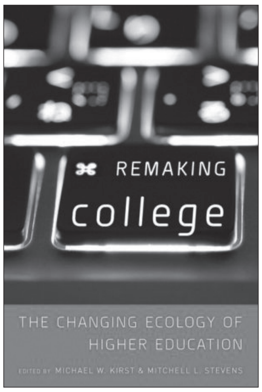
CUR Book Review

Remaking College: The Changing Ecology of Higher Education

Edited by Michael W. Kirst and Mitchell L. Stevens

Reviewed by Susan Berry Brill de Ramírez, Bradley University, brill@bradley.edu



Stanford, CA, Stanford University Press: 2015. 323 pages.

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Michael W. Kirst and Mitchell L. Stevens have brought out a timely and valuable collection of essays for all higher-education administrators and faculty members to read and consider. There is no one connected with a college or university who is not deeply aware of the tremendous changes that are affecting higher education in the United States and globally, whether brick and mortar institutions, online programs and MOOC's, or for-profit schools. Kirst is the current president of the California State Board of Education and an emeritus professor of education at Stanford University. Stevens, also at Stanford, is an associate professor of education and sociology. In looking at the epochal changes that are transforming higher education today, their book begins to answer how we are to go forward in meaningful, realistic—and visionary—directions. Stevens ends the Introduction by asking, "What is college for?" Drilling down into the ecological fabric of institutions and their dynamic environments, he asks us to consider "Which species of life in the higher education ecosystem are essential to preserve, which are best lost to history, and what new kinds should be seeded and encouraged?" (15). The book does not tell us how to proceed with programming and policies, but it does begin to answer the question by delineating the key elements and research regarding the "changing ecology" of higher education today.

We can immediately see the relevance of this for high-impact pedagogical practices (for example, undergraduate research) that are of great value for student outcomes, including improved student interest, motivation, engagement, persistence, retention, graduation, grades, and many of those hard and soft skills sought by employers: statistical analytics, logical analysis, critical and creative thinking, communication skills (oral, written, digital), and problem solving. The larger focus of the volume is on delineating and exploring the external and internal factors and demographics of the higher-education terrain.

The book is divided into four sections: "Understanding the Changing Ecology," "College and the Life Course," "Assessment and Governance in the Changing Ecology," and "A New Research Agenda." The first four essays provide interesting perspectives through which to analyze and understand higher education in America. For example, W. Richard Scott's analysis of "higher education as an organization field" with both inertial and dynamic properties and elements (19) brings organizational theory forward to look at institutional change and those factors that contribute to or hinder change.

Anya Kamenetz, a leading education blogger for NPR, provides the second essay: "DIY U" or the "Do It Yourself University." She addresses a range of topics, including technology and online learning, microcertifications, MOOC's and their crowdsourced teaching assistants, and how the new dynamism is propelled by cost considerations, educational needs, and outcomes. Paul Fain and Douglas Lederman turn directly to for-profit colleges and their "slow but inevitable drive toward acceptability" (61). Continuing the focus on the various ecological categories of higher-education institutions, Martin Ruef and Manish Nag point to problems with the Carnegie Classification system, explaining that many central factors that determine the organizational mission and work of tertiary institutions are ignored in the Carnegie taxonomy. They advocate throwing out the Carnegie categories altogether "in favor of alternative perspectives on organizational classification" (108).

Turning to the "life course," Richard A. Settersten, Jr., introduces crucial elements of broad-access institutions along with their successes and challenges, especially those regarding specific student demographics and educational outcomes over time. Regina Deil-Amen then discusses "traditional" college students, noting that they are increasingly a minority among college students. She asks, "What happens when a norm of behavior becomes the exception numerically yet the social construction of that norm remains prominent?" (134). Higher education is changing, but not quickly enough to meet the needs of today's students. Richard Arum and Josipa Roksa, authors of the book *Academically Adrift*, contribute an essay, "Measuring College Performance," in which they advocate measurements of such things as graduates' wages and students' learning outcomes. This extends their analysis in *Academically Adrift*, in which they pointed out the extent to which students are not significantly improving their "critical thinking, complex reasoning, and written communication" during their college years (171).

In their compelling essay "Improving Collegiate Outcomes at Broad-Access Institutions," Michal Kurlaender, Jessica S. Howell, and Jacob Jackson continue the volume's emphasis on the importance of better research and data in order to generate institutional policies and practices that will drive the needed improvements in American higher education. They ask, "What practices might account for institutional variation in rates of freshman completion and time-to-degree? Prior research suggests that student-interaction with faculty, student peers and sense of community, active engagement with the institution, and mentoring all contribute to higher rates of persistence" (239).

Over all, this is a volume that calls for research into the needs of higher education generally and individual institutions specifically. Although the importance of undergraduate research is not mentioned at all in the text, the editors and authors call for research to help colleges and universities navigate the changes in the complex ecology that surrounds higher education today. While not specific to traditional disciplinary fields, it would seem that such research would be a perfect fit for broad-scale undergraduate research programming across the country—and of direct value for implementing institutional policies and programming that produce heightened student outcomes.

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The *CUR Quarterly* publishes articles relating to all aspects of undergraduate research that are of interest to a broad readership. Articles regarding the effects of the research experience on the development and subsequent endeavors of students, and how to initiate, support, or sustain undergraduate research programs are appropriate for this journal. The *CUR Quarterly* is not the appropriate venue for publishing results of undergraduate research.

Manuscripts that are unrelated to undergraduate research or focus on the success of an individual or institutional undergraduate research program without providing a substantive presentation of goals, strategies, and assessed outcomes related to the program are not suitable for publication. Manuscripts that describe novel programs that can serve as models for other institutions, those containing significant assessment of outcomes, and those articulating research on the efficacy of undergraduate research programs are particularly suitable for publication in the *CUR Quarterly*.

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- Title and department or program affiliation of the faculty member.
- A brief description of the student co-author(s). Include the year of study in which the student(s) undertook the work, the opportunity through which the work was undertaken, (independent study project, summer project, REU program, senior thesis project, etc.), and the current status of the student (graduate school, employed, still enrolled, etc).
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