CURQ Web Vignettes

Community-based Research with Podcasting in Introductory Geoscience Courses

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Using undergraduates to conduct community-based research projects can accomplish several goals—fulfilling an identified need with and for a community partner; connecting classroom work with the mission of the university; and aiding students in learning how to make effective use of technology. Two audio podcasting examples from introductory-level courses at Penn State Brandywine demonstrate this. One project was conducted in the Earth & Life course, and the other was completed in the Water: Science and Society class. Both courses are designed for non-science majors and satisfy a general-education science requirement for graduation.

For the Earth & Life course, students partnered with a local state park, Ridley Creek State Park, which has a five-mile multi-use trail with trees tagged with numbers. Walkers and hikers are challenged to try to identify the trees spaced along the trail, then go check the answer key in the park office, which is not located along the trail. Unfortunately, with more than 40 tagged trees, the park was not able to successfully accomplish its educational mission using this model. The students collaborated with the education officer of the park and the organization Friends of Ridley Creek State Park to create an informative podcast with information on tree biodiversity, along with photos. The students created a second virtual tour of tree biodiversity in Google Earth for people who are unable to visit the park, thus expanding the park's outreach.

The project in the Water: Science and Society course was not driven by the instructor, but instead was put in place at the request of the students. The students developed an idea during the semester to conduct a two-week awareness campaign, to kick off on Earth Day, focusing on global water issues. The campaign involved podcasts and social media tools, including the microblogging site Twitter, the blogging platform Tumblr, and the social bookmarking tool Delicious. The students generated twenty podcasts on local-to-international topics that ranged from water conflicts and pollutants to interviews with leaders of non-profit water organizations. The goal was to spread the word about water issues to the campus and to a larger online community.

For both of these courses, the decision to incorporate student-generated audio podcasts was rooted in the overarching and secondary course goals. It was important to ensure that class time spent with technology instruction and podcast creation did not have a negative impact on the instruction in science content. In addition to confirming that technology use would match and enhance the course's goals, it was important to confirm that the necessary recording and editing equipment was available for the number of students needing to use it, that time was available for recording and editing, and that students could seamlessly share their resulting large podcast files with the instructor and the community partners.

A significant outcome of the podcasting projects targeted for the community was what students learned beyond the science content and effective use of the technology. For the Ridley Creek State Park project, the students presented their work as a poster at NCUR (National Conferences on Undergraduate Research) and published a project summary in the *Journal of the Pennsylvania Academy of Science* (Woodruff et al. 2009). The podcasting and social media campaign on water issues was picked up and shared by the Science Centre Singapore. Most importantly, for both podcasting projects, students learned how their original products were of interest and of use to others beyond the classroom walls.

Reference

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Systems Analysis and Design of a Web-Centric Information System

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For my System Analysis and Design course, I arranged with a local non-profit organization to let my students analyze the organization's current information system and design a new web-centric information system for the organization.

The organization is a public entity that offers cultural, sports, fitness, and daycare programs, as well as several community services. It publicizes its programs and services via a static website, pamphlets at local establishments, and flyers sent home with school children.

Currently the organization handles all of its correspondence with customers via telephone, email, mailed newsletters, or the flyers. Registration for programs (including weekly scheduling for daycare) is done by the customers, who must download a form from the web, fill it out and either mail it to the organization or give it with payment by check to a staff member at an activity. Reserving a pavilion or sports field is done much the same way. After receiving the paperwork, the staff then enters the information into a spreadsheet and accounting program, sends a list of participants to the program's instructor, and deposits the check in the bank. The spreadsheet is saved on only one computer in the office.

The system analysis and design project was set up as a kind of research competition. The students were divided into four groups and given a set of requirements for the new web-centric information system. Each group met with the director of the organization several times to analyze the current work flows, information flows, and staff responsibilities. The groups then researched and designed new web-centric information systems for the organization. The groups were able to email or telephone the director and me at any time with questions or suggestions. The groups periodically presented their designs to me and to the organization's director; we gave them feedback regarding areas that needed improvement or needs that were not addressed.

During the last week of the semester, each group presented its final web-centric information system design and prototype (if available). The organization's director and I determined the winning design and prototype. Each design was scored based on the requirements outlined at the beginning of the project and the group's response to

the feedback received throughout the project, which also counted towards the grade on the project. The winning team received a gift certificate for dinner at a local restaurant.

As anticipated, the proposed web-centric information systems would allow a significant reduction in the time required for staff to enter information into the system, and they would diminish the potential for errors by the staff. All the proposed systems' designs included online registration and/or reservation and payment methods, and most included the ability to schedule weekly daycare online, along with confirmation emails and the ability to print the registration forms for mailing if the customer so desired. Most of the proposed systems replaced the spreadsheet with an online database provided by the web site hosting company, with the capability to download the information in various formats (e.g., as a database or spreadsheet).

This experience corroborates the findings in earlier literature. The students benefitted in several ways, for example, gaining the opportunity to apply the knowledge gained in the classroom to real-world challenges and learning to deal with interpersonal relationship issues in a workplace setting. They also were able to work on a socially relevant project that would have a visible impact, which often motivated them to do their best work. They had the experience of producing a complete hardware and software design project to meet a real customer's requirements, another potential motivating factor. They learned the need to focus first on understanding the customer's requirements and developing a high-level design prior to formulating a solution. And they also experienced having an impact on the reputation of the university in the community (Lazar and Lidtke 2002; Buckley et al. 2004).

After the project was finished and the winner announced (which was presented as "the contract is awarded to…"), the class discussed the lessons learned. Several of the students recommended more formalized group communications among group members, the need for specific division of labor within groups, and regularly scheduled meetings with the organization's director. They relished the experience of doing a hands-on project rather than a case study from the text. The organization's director learned that not only are students quite capable of bringing current technology to her organization, but also that they can provide a wealth of knowledge on how to use technology to accomplish many tedious tasks that may be subject to human error.

Significantly, after the course ended, the organization's director hired a few of the students to implement a new web-centric information system, which included not only features from the winning design, but a few of the features from the other designs.

References

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VIPEr: An Online Academic Resource Enhancing Undergraduate Research

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VIPEr, the Virtual Inorganic Pedagogical Electronic Resource (http://www.ionicviper.org), was developed by a small group of inorganic chemists from predominantly undergraduate institutions as both an online repository of teaching materials and an interactive social networking environment for inorganic chemistry educators. In addition to offering learning objects (small instructional units), VIPEr offers many interactive activities, including discussion forums on research and teaching, discussions of various textbooks, and polls. The VIPEr resources include materials designed to guide students in searching and reading the primary literature; to provide community support and forums that offer advice to faculty engaged in undergraduate research; and to support inter-institutional collaboration.

Because many inorganic chemists direct undergraduate research, learning objects (LOs) on the site frequently connect in some way to research. These LOs have utility outside of the classroom and are particularly useful in training undergraduates for research productivity. There are LOs on keeping laboratory notebooks, using laboratory equipment, assessing and reacting to hazards in the laboratory, and conducting research ethically. VIPEr has made the inclusion of the primary literature in the education of inorganic chemists a priority. In addition to continued submissions from the community of inorganic chemists, participants in workshops over the next four summers will develop up-to-date, literature-based materials in collaboration with research leaders in four different subfields of inorganic chemistry.

VIPEr supports a broad range of community conversations through its forums. Questions posted to the forums typically receive rapid and helpful responses, and the site provides mentoring and support to faculty working with undergraduate students. Forum discussions range from logistical questions about organizing a research group to practical questions about laboratory equipment. Faculty also share technical expertise on research-focused questions. Broader conversations about grant writing, tenure, and dealing with department politics enable faculty to learn and problem-solve within a supportive community of peers. Users post invitations to meetings for undergraduates and their mentors and post summer research opportunities for students.

The VIPEr community facilitates inter-institutional research collaborations by bringing together inorganic chemists having complementary backgrounds. For example, a collaboration of two inorganic chemists at liberal arts institutions in California and Indiana began as a simple "ask the expert" activity. An inorganic chemistry class at Earlham College read a journal article by a faculty member at the Keck Science Department of Claremont McKenna, Pitzer, and Scripps Colleges. This faculty member then met with the Earlham students via video conference in order to talk more about the science presented in the article and to answer questions the students had. The students were enthusiastic about engaging the author of a paper they were reading and enjoyed asking general questions about the process of doing science (e.g., How did you come up with this idea? How did you figure out what was going on in the reaction?), as well as more specific questions about the research.

Subsequently, because of online contacts through VIPEr and face-to-face meetings, the two faculty members began a further collaboration, taking advantage of the different research strengths of the individuals. The strengths in synthetic and mechanistic chemistry of one faculty member complement the other's expertise in the computational study of transition metal complexes. Thus far, this collaboration has produced preliminary results, a grant submission, and the remote co-mentoring of a research student performing computational chemistry studies. The discussion questions about the research literature that were used in the original "ask the expert" activity have been published on VIPEr.

While such collaborations have always been possible, the use of video conferencing and social computing have made joint projects much easier and more accessible to faculty with very limited time to explore new research directions. The new tools also have given the students involved a sense of how scientific collaborations can tackle bigger problems than any one person has the expertise to solve alone. With a discipline-specific online resource such as VIPEr, it is easier to identify potential collaborators and to facilitate those collaborations with materials available for wider use.

VIPEr is transforming the undergraduate research experience by allowing student and faculty researchers to come together across institutional lines. The online community provides a series of remarkable technology-enabled opportunities for student training, faculty development, and research collaboration and advancement.

Using Mobile Technology to Enhance Undergraduate Research

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Keeping a detailed and updated laboratory notebook is essential for any research project. This is especially important when working with undergraduates, since often one student picks up a research project when another student leaves. In our experience in ecology (Anderson) and biochemistry (Murray), students end up with data in more than one place, making it difficult to start another student on the project or to write a manuscript for publication. In addition, upon graduation, some students are expected to use electronic record-keeping in their new jobs, and they quickly find that they lack the experience to do so. In May 2012, we began using an electronic lab notebook (ELN) with students in our field and lab research projects. The LabArchives© (www.labarchives.com) ELN was implemented, and tablet computers (iPads) were purchased through internal grants.

To date, we have supervised six students on multiple projects using the tablets and/or ELNs. Anderson has implemented the use of the tablets and the ELN to record live-trapping data for small mammals at Capital University's field research site at the Primmer Outdoor Learning Center; she has also used it in laboratory work. Murray has incorporated the tablets and ELN in indoor laboratory spaces. This work occurs in various research and instrument labs in the chemistry department, some equipped with desktop computers and some not.

To assess the students' experience and attitudes toward ELNs and tablets, they were asked to complete a pre-assessment questionnaire (scale 1 – 5 or N/A with 1 = no interest, 5 = extremely interested). Five students completed the pre-assessment. The students generally had a positive attitude toward their paper lab notebooks and no experience with ELNs. Most had positive previous experience with tablet technology (average rating for that technology was 5.0 with one responding N/A). The pre-assessment included four separate questions about various uses of technology (spreadsheets, camera, apps, and the ELN). The average rating was 4.8 (with two students responding N/A for one question), showing that the students were very interested in using technology in their research projects. Qualitative responses from the students were mixed. Most students recognized that the data collection would be more efficient and easier with the tablets, but some students were concerned about losing the ability to draw and the "freedom of pen-and-paper".

Having now used the tablets and ELN for 10 months, we can reflect on our experiences and observations during this trial period. As expected, data collection is now more efficient since the data can be recorded directly in the field, with no need to transfer written data to a spreadsheet later. There have been no issues with keeping the tablet dry in a waterproof bag or problems viewing the screen under various light conditions in the field. In fact, it was easier to keep the tablet dry than paper data sheets. There was a learning curve for the students using the tablet keyboard and the spreadsheet application, but they quickly adjusted. Taking pictures with the built-in camera using the ELN app also saves time and has resulted in the students taking more pictures. This should allow the students to include more photos in oral and poster presentations.

It has taken some time to find written protocols and get these uploaded or entered on the ELN, but they are updated more easily as changes to procedure arise. The protocols are also easier to locate once they are uploaded. Students who have worked on projects during previous semesters appeared to keep more detailed and complete records by creating a new entry each day in the ELN, compared with their less-frequent updating of a conventional notebook. This suggests our students are comfortable with these technologies and are more likely to keep their electronic notebooks updated.

As our students finish their projects and graduate, we will collect post-assessment data on their use of both mobile technologies. Our plan is to continue the use of tablets and the ELN in our research programs, and to further evaluate their impact on student learning based on more rigorous assessment with a larger sample of students. On our campus, we are engaging faculty within and outside our disciplines in the use of tablets in scholarship with undergraduates. We also encourage our students to include information not only on their scientific research projects but also on their experience using tablets and ELNs when they make presentations on campus at our Symposium on Undergraduate Scholarship, as well as in any presentations off campus. The goal is that the successful use of these tablets by our research students will serve as a "pilot study" and allow us to expand the use of technology in the other laboratory courses at our institution.

Transforming Community-Based Studies with Mobile Apps

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Undergraduate research is an appealing challenge as today's higher-education institutions seek to increase the educational impact of the undergraduate experience by providing, rewarding, exciting, and active learning experiences. Most research projects in the past have predominantly been targeted at and conducted by graduate students. Too often, faculty feel that serious or meaningful research can only be achieved by graduate students. However, undergraduates easily become bored in a classroom and are often not motivated to learn or participate in class activities to the best of their abilities unless a practical connection to the course context is made clear. Providing undergraduates in all majors with real-world, service-learning projects in collaboration with community partnerships has proven successful in the area of mobile technology.

Within a second-level, service-learning computing course, Intergenerational Computing, undergraduates are challenged at the beginning of the semester to develop projects they are passionate about and that will make a lasting difference in the community. Early in the semester, representatives from community partners visit the campus to discuss their technology needs with the students. Students meet with groups they are interested in helping to select the one they are most comfortable with and that sparks their enthusiasm. Many community partners need mobile apps developed to help their residents and patrons improve their quality of life. Students are strongly encouraged to select for members of their teams students with diverse skills, for example in programming, web development, marketing, graphic design, communications, business, finance, etc. Thus, computer science majors join with students from other disciplines who can design icons, carry out usability testing, create business plans, perform marketing research, and investigate competitors. Additionally, outside the classroom, undergraduate research teams are formed to implement the research projects.

In addition to the excitement of entering student mobile-app competitions, students respond enthusiastically to face-to-face meetings with representatives of the community partners to learn more about the proposed projects. Students see first-hand the needs, as well as the appreciation of the work performed and how it will be utilized. And competitions naturally spark commitment and lay the foundation for teamwork. College- and school-based, regional, national, and international mobile-app competitions allow for teams with different levels of expertise to participate.

Examples of student projects on our campus have included developing mobile apps that assisted the elderly and disabled in using computers with voice recognition and synthesis, reminding them to take medications, and encouraging use of email and social networks. Other apps developed aimed at improvement of cognitive functioning in older adults, as well as creating "sundown" apps to engage dementia and Alzheimer patients during peak agitation times that occur frequently during late afternoon and evenings. These apps were developed for iOS and Android platforms. Current projects include designing and testing biometric security apps targeted at the disabled population, as well as apps to rapidly determine stages of dementia.

The challenges in this process consist of finding community partners that will be good to work with, finding support for students to enter or host competitions, and obtaining grants for student research assistantships outside the classroom. Not all community partners desire to engage in undergraduate research-based collaborations. Seeking out local government agencies may facilitate quicker matches with community partners. Some funding resources are helpful in supporting team travel, as well as helping meet periodic hardware and software requirements. Research data and partnerships form the basis for obtaining grants to support student stipends outside the classroom and summer research opportunities.

Students are happily challenged by the opportunity to work on mobile apps, giving up social time in exchange for an intense learning experience and good resume-building activities. Students have said that they were gratified to utilize the skills learned in other classes and apply them to a real-world setting. Mobile app projects have led to our students winning national and international awards, being offered elite paid internships, and successfully starting their own companies. The projects also have generated conference presentations and publications