

Discussing the Human Life Cycle with Senior Citizens in an Undergraduate Developmental Biology Course

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Abstract

A civic engagement project was designed for undergraduate students in a developmental biology course to promote their understanding of the material as well as its relevance to issues in the local community. For this project, students prepared posters that focused on different stages of the human life cycle: gametogenesis, fertilization, embryonic development, fetal development, childhood (including adolescence), and adulthood (including senescence). Their posters were accompanied by activities designed to further engage the senior citizens who visited during a lab period at the end of the semester. While the senior citizens completed surveys, the students wrote short essays reflecting on the value of the project. The surveys demonstrated an increase in the senior citizens' understanding of human development and of current issues related to the discipline. The students' essays revealed that the project was beneficial for many reasons, most notably because it fostered a sense of civic responsibility among the next generation of scientists.

Introduction

Civic engagement is a pedagogical strategy that is successfully employed in a variety of educational contexts (Colby et al. 2003). It is particularly well suited for undergraduates, including those at liberal arts institutions, where the mission often encourages interdisciplinary integration of skills and knowledge to engage with critical issues facing society. The incorporation of civic engagement into specific courses has reciprocal benefits for the students and the local, national, or even international communities to which they belong. Students gain critical insight into specific topics addressed in their coursework while also developing a sense of civic responsibility. In turn, communities may receive benefits when projects promote "quality of life" as envisioned in one definition of civic engagement (Ehrlich 2000). Such projects usually focus on important issues including, but not limited to, poverty, hunger, disease, voter registration, and environmental contamination; moreover, they impact a variety of constituencies, ranging from individuals to groups such

as agencies, businesses, and non-profit organizations. While civic engagement manifests itself in diverse ways, there are some common themes, such as clearly defined learning goals and the opportunity for students to reflect carefully on the educational value of the experience. In many cases, academic credit is based on learning and not the on outcome of the project itself (Howard 1993).

Civic engagement is often discussed in the context of coursework in the social sciences. However, it has been argued that it is equally important that such pedagogy be implemented in the natural sciences, for a variety of reasons (Kennell 2000). For example, the projects can provide students with a better sense of how their acquired knowledge is, in fact, relevant to “the real world.” The projects can also help to educate citizens in the local community who have little or no background in the natural sciences, but who must often vote on issues related to the use of stem cells in regenerative medicine, the protection of organisms from the effects of climate change, and the creation of genetically engineered organisms to deal with agricultural pests. In fact, the estimated percentage of citizens who are “scientifically literate” is only 28 percent in the U.S. (Raloff 2010). In addition to promoting scientific literacy, the projects can help to demystify the process by which scientists collect and analyze data, which is important given the results of recent surveys reported by the National Science Board (2012). A variety of effective projects have already been implemented by scientists, including one in which students used emerging technologies as tools in projects related to environmental sustainability and designed to meet the specific needs of their community (e.g. an interactive trail map for a nature preserve prepared using GIS) (Green 2012). In the case of this particular project, the faculty member asked the students to complete surveys, provide anonymous feedback, and write an essay reflecting on their experiences. This project and others provided the inspiration for my own recent initiatives to incorporate civic engagement into advanced biology coursework.

Description of the Service Learning Project

I have incorporated a civic engagement project into a developmental biology course at Denison University, a small liberal arts institution in Granville, Ohio. An undergraduate course

in developmental biology usually focuses on model systems—the fruit fly, frog, and chicken, for example— from which biologists have gained insight into the molecular basis of human disease and development. Fertilization, cleavage, and gastrulation are quite complex; accordingly, instructors usually devote several weeks to these earliest stages of embryonic development. In the absence of conversations about issues like stem cell research, however, it is easy for students to lose sight of the “big picture.” I therefore decided to design a project that would allow students to “come full circle” at the end of the semester by having them engage in a conversation about the human life cycle with local senior citizens. I chose to have the students work with senior citizens since many of the campus outreach programs are focused on local youth. In addition, I expected that the senior citizens would have many interesting, relevant experiences to share with the students, and that they would be a more appropriate audience given the nature of the course material.

For the project, I divided my 24 students into six groups, each focusing on one stage of the human life cycle: gametogenesis, fertilization, embryonic development, fetal development, childhood (including adolescence), and adulthood (including senescence). I provided each group with a poster template with three sections titled “Concept,” “Concept Explained,” and “In the News.” In the “Concept” section the students defined their stage in no more than two or three sentences, while in the section titled “Concept Explained,” the students provided more detailed information and, in some cases, divided their stage into several distinct steps (e.g. sperm attraction, acrosome reaction, fusion of the plasma membranes, prevention of polyspermy, activation of egg metabolism, and fusion of the genetic material, in the case of fertilization). Finally, in the section titled “In the News,” the students provided information on one recent issue, debate, or controversy related to their stage (in the case of fertilization, for example, the availability of a male contraceptive). In addition to the poster, I asked the students to develop a simple activity to further engage their audience. I provided them with a few ideas—completing a quiz, watching a short video on a laptop, and examining eggs, embryos, and/or larvae under a microscope—although I encouraged the students to think creatively about other options to facilitate learning. As the final component of the project, the students wrote a short essay on the value of civic engagement in the context of a liberal arts education and one thing

they learned from their interactions with senior citizens. I was particularly interested in having them reflect on the value of this educational strategy in the natural sciences.

Other than providing them with a poster template, I offered little or no guidance to the individual groups; the students assumed responsibility for their poster displays as well as for the tasks required to prepare for the arrival of the senior citizens. During their visit, student volunteers escorted the senior citizens from one station to the next, giving them at least ten minutes to learn about each stage of the human life cycle. In many cases, the senior citizens were so engaged with the material that they remained at a station for much longer in order to ask questions and/or have an extended conversation with the students. The students ensured that there was sufficient seating in front of each poster display, since many of the senior citizens spent a total of about two hours rotating through the different stations. They had learned about this opportunity through an e-mail sent to retired staff or through an advertisement in the local newspaper, although a few were recruited from a local senior center by the John W. Alford Center for Service Learning at Denison. Snacks were purchased from the Smiling with Hope Bakery, which is run by special-needs students at Newark High School in Newark, Ohio.

Outcomes of the Service Learning Project

In an effort to assess the senior citizens' learning, I prepared a short survey in which they rated their understanding of 1) human development, and 2) current issues in developmental biology both before and after visiting the poster displays. A total of 17 local senior citizens were recruited for the project, with thirteen of them completing the survey at the end of the afternoon (Table 1). In both cases, there was a statistically significant increase in their understanding, with several individuals offering positive comments about the experience, either through e-mail or through comments at the bottom of the survey. Indeed, students noted in their essays that the senior citizens were "focused," "inquisitive," and "enthusiastic," with "a genuine interest in learning." As the afternoon progressed, I came to realize that the senior citizens were modeling the idealistic concept of "lifelong learning" for my students through their intellectual engagement (McClure 2013).

To assess the students' learning, I evaluated their poster displays and the essays that they wrote following the senior citizens' visit. Since this was a pilot project, each component was worth only five percent of their final grade in the course. As I had expected, many students indicated that teaching what they had learned in the course helped them to gain a more complete understanding of important concepts in developmental biology. On a related note, they recognized civic engagement as an effective strategy to improve upon their communication skills. Many students also appreciated the opportunity to leave the "bubble" of campus life and interact with members of the local community, while learning how to "effectively converse [with them] about key issues facing society." However, the students' essays revealed that the project was beneficial in ways that I could not have predicted. For example, many students described their initial uncertainty about the value of civic engagement, but then wrote about how they came to view it as an "innovative way to incorporate many themes from our mission statement" and "a prime example of the types of endeavors [the institution] should continue to pursue to more fully provide its students with a liberal arts education." They recognized it as an opportunity to "interact with diverse groups of people" and to "facilitate [their] growth into change makers that will work to fix the problems faced by humanity." Several of them even described how rewarding it was to communicate knowledge with those who may not have had the opportunity to pursue an undergraduate education, noting their status as "privileged students," who have a responsibility to "share [their] experience with others."

Conclusions

I was quite satisfied with the extent to which the students reflected on the project and expressed "joy" (in their own words) in having the unique opportunity to engage with the local community as part of a biology course. In the future, I hope that this project will be extended to senior citizens from more impoverished communities, perhaps with students actually meeting them at a retirement facility. In addition, I hope to design alternative projects that address senior citizens' specific interests (besides the human life cycle), since some of our visitors indicated on their surveys that they wanted to learn more about such topics as environmental influences on aging. And finally, I hope to encourage my peers to consider incorporating

TABLE 1. Mean responses on pre- and post-surveys administered to senior citizens participating in the service learning project.

On a scale of 1 (low) to 5 (high), rate your...	pre	post	t _{20,86}	p
1. Understanding of human development.	3.54	4.27	-3.32	0.0032*
2. Understanding of current issues in developmental biology.	2.92	4.00	-3.27	0.0041*

a civic engagement project into their own courses, since this educational strategy obviously has much to offer to students in the natural sciences, even in the realm of cellular and molecular biology. It can be easily accomplished during a single lab period, although it can be more extensive with activities spanning one or more semesters (e.g. Hark 2008; Imoto 2013; Larios-Sanz et al. 2011; Santas 2009). Regardless of the size and scope of the project, civic engagement can transform students' thinking and inspire them to make important contributions to the world, whether as a nurse, teacher, or conservation biologist. It should be an integral component of every academic institution, "across all fields of study" as the National Task Force on Civic Learning and Democratic Engagement has declared (2012). In summary, I would argue that scientists have an important role to play in developing students' sense of civic responsibility in the 21st century.

About the Author



Laura Romano is an Associate Professor in the Department of Biology at Denison University in Granville, OH. She earned her BS in Biology from the College of William and Mary, and her PhD from the University of Arizona. She also completed three years of postdoctoral research at Duke University. She teaches introductory biology courses as well as advanced courses in developmental biology and invertebrate zoology. In addition to teaching, she enjoys advising students and mentoring them in her laboratory where she studies the evolution of developmental mechanisms using the sea urchin as a model system.

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