Service-Learning in Entomology: Teaching, Research, and Outreach Domestically and Abroad

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Abstract

Insects are ideal models for demonstrating an array of biological and ecological concepts and the application of biology to solve real-world problems. Integrating service-learning, a pedagogy bridging theory and practice, into the entomology curriculum at the University of Georgia provides students an opportunity to participate in developing and implementing entomological programs for communities, both domestically and abroad. This research project seeks to develop, implement, assess, and evaluate two service-learning courses in entomology: Entomology Outreach and Service-Learning (ENTO 3900) and a study abroad course, Insect Natural History in Costa Rica: International Service-Learning (ENTO 3140-3140L). A qualitative research study was designed to assess and evaluate the courses using guidance from student reflections. Results suggest that entomological service-learning courses can be integrated with community outreach programs, both domestically and abroad, to enhance students' science content knowledge and their teaching, communication, and civic skills.

Introduction

Service-learning is a teaching and learning strategy that integrates meaningful community service with instructional planning and reflection to enhance the students' learning experiences, teach civic responsibility, and strengthen communities. Eyler and Giles *(1999)* define service-learning as a form of experiential education where learning occurs through a cycle of action and reflection as students work with others through a process of applying what they are learning while simultaneously reflecting on their experiences and seeking to achieve real objectives for their communities and a deeper understanding and skills for themselves. Service-learning also bridges theory to knowledge as civic responsibility and public work *(Boyte and Farr 1997)*. Students can discover the importance of addressing their needs as individuals and as members of a community. Problem-based learning, collaborative learning, undergraduate research, critical thinking, multiculturalism and diversity, civic awareness, leadership

skills, and professional and social responsibility are all associated with service-learning programs *(Zlotkowski 1998)*.

Service-Learning as Pedagogy to Improve STEM Undergraduate Education

Service-learning as a pedagogy to improve science, technology, engineering, and mathematics (STEM) undergraduate education has been researched in several science disciplines, but such research is lacking in entomology. There is a general consensus that our national future is dependent upon undergraduate education in the STEM disciplines. Incorporating service-learning into science courses has demonstrated positive effects not only on student learning, but on cultural diversity, civic engagement, recruitment, retention, and global awareness. The needs of K-12 science education are strongly linked to undergraduate education.

Although there have been numerous publications about service-learning assessments in general, research has been limited in the sciences and absent in entomology. Most science service-learning research has been in the health sciences (nursing, physical therapy, etc.), biotechnology, engineering, biochemistry, geology, natural resources, wildlife, and science education *(Scott, Oliver, and Knauft 2007; Benore-Parsons 2006; Slivovsky et al. 2004; Millenbah and Millspaugh 2003; Montgomery 2004; Straka 2005; Kurdziel and Libarkin 2002; Ropers-Huilman, Carwile, and Lima 2005; Galantino et al. 2006; Dukhan, Schumack, and Daniels 2008; Hark 2008)*. More in-depth studies in the natural, life, and applied sciences concerning the effectiveness of service-learning as a pedagogical method are needed.

Furco and Billig *(2002)* describe mechanisms for establishing norms for scientific inquiry in service-learning. The National Research Council's principles for scientific inquiry provide a foundation for guiding scientific research in all disciplines. Furco and Billig suggest that by applying these principles to the study of service-learning, the quality of service-learning research can be improved and norms for service-learning research can be established.

These findings indicate that science students can learn course-specific objectives while being exposed to society and experiencing this interaction firsthand. In an effort to address this need in STEM undergraduate education, the Entomology Department at the University of Georgia (UGA) developed two service-learning courses, Entomology Outreach and Service-Learning (ENTO

3900) and Insect Natural History in Costa Rica: International Service-Learning (ENTO 3140-3140L). First, the development of Entomology Outreach and Service-Learning (ENTO 3900) is discussed. Next, two service-learning projects associated with the Entomology Outreach and Service-Learning course (the apiary and the outdoor classroom) are described. Finally, the development of Insect Natural History in Costa Rica (ENTO 3140) is described.

Entomology Outreach and Service-Learning, ENTO 3900

In 2005 a service-learning partnership was developed between Classic City High School: A Performance Learning Center and a group of UGA faculty, staff, and students interested and engaged in service-learning. The primary goal of the partnership was to cultivate dialogue and projects between Classic City High and UGA addressing community needs as defined by Classic City High School. Classic City High was created in 2003 to address significant dropout rates in Athens–Clarke County and is a partnership between Communities In Schools, Clarke County School District, and the Bill and Melinda Gates Foundation. Communities In Schools is a community-based organization that, by bringing caring adults into the schools to address children's unmet needs, provides the link between educators and the community. It is a nontraditional, voluntary high school, where students receive diplomas. The curriculum is provided predominantly through an electronic system, NovaNet, with elective courses such as Entomology. The school hours are Monday to Thursday, 10 a.m. to 8 p.m. Needs were identified and established by Classic City High School, and collaborative projects were proposed based on these needs. Goals and objectives of the specific annual projects were jointly determined by the high school and UGA. When determining projects, four aspects were jointly considered: mutually beneficial, sustainable, linked to the curriculum, and reflection opportunities. The determined projects needed to be beneficial to both the high school and to UGA. Since the projects were on the grounds of the high school, it was also important for the determined projects to be sustainable. Entomology is a course offered at the high school, which linked the projects directly to the curriculum at both the high school and UGA. Lastly, reflection opportunities were incorporated into the course and into the projects to provide opportunities for both high school and university students to reflect on the project and their experiences.

Entomology Outreach and Service-Learning (ENTO 3900) was first offered spring 2006 at UGA. Students participate in a guided study of developing entomological educational programs for the public (mostly children) in the Athens/Atlanta area, which includes identifying needs, establishing objectives, and designing and evaluating entomological educational programs. Students enrolled in this course spend significant time in local schools and community organizations hosting educational entomological programs with live and preserved insects and other arthropods.

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Students participate in weekly reflection activities, beginning each class with reports of the previous week's outreach activities. Each student is also required to participate in a service-learning project with our community partner Classic City High School. All students are required to have ten outreach and service-learning hours per credit hour enrolled over thirteen weeks: that is, approximately one to three hours of outreach activities outside class per week. This may include planning, preparing, commuting, and facilitating outreaches.

Methods

During spring 2006, six undergraduate students and two high school students from our community partner school, Classic City High School, enrolled in Entomology Outreach and Service-Learning. In spring 2007, fifteen undergraduate students and one Classic City High School student registered. And during spring 2008, fourteen undergraduate students enrolled in Entomology Outreach and Service-Learning. Total participation in this three-year research study consisted of thirty-eight students. There were twenty-five males and thirteen females. All students agreed to be participants in this study and indicated this agreement by signing a consent form the first day of class. Participation in the survey was voluntary and students' grades were not affected by their participation.

Students enrolled in Entomology Outreach and Service-Learning were required to submit weekly writing assignments. Topics included service-learning as a pedagogy, grant writing,

entomology myths, and critical thinking. Class time was spent discussing each of these topics weekly. Students would share their findings and writings with fellow class members, and discussions would follow. This proved to be a very effective way for students to reflect on their own opinions and personal biases while simultaneously engaging in the current literature and resources associated with the writing assignment topics.

Outreach activities ranged from visiting K-12 classrooms for an instructional outreach program with twenty to fifty participants to presenting for large festivals with hundreds or sometimes thousands of participants. Spring 2006 students participated in over thirty outreaches reaching nearly 3,600 children and other community members. Spring 2007 students participated in approximately thirty outreaches with over 4,000 total participants. Spring 2008 students organized and conducted over thirty outreaches reaching almost 3,800 individuals. Ages of our target audiences have ranged from three- and four-year-olds to elementary, high school, and college students, to adults or the elderly community.

Classic City High apiary service-learning project

As a class service-learning project, spring 2006 Entomology Outreach and Service-Learning students wrote a proposal for a university minigrant and were funded to build and establish an apiary (bee colony) at the Classic City High School. Students were required to research supplies and equipment necessary for building and sustaining an apiary and included these costs in the proposal budget. Once the grant was received students purchased the necessary equipment to build the frames and supplies to work and sustain the hives. Beekeeping equipment, including hive bodies, supers, frames, foundations, beekeeping tools, smokers, and protective clothing, was purchased with the grant funds and donated to the high school. In May 2006, three bee colonies were placed at Classic City High. Each of the three colonies had drones, worker bees, and a queen.

Each fall entomology is offered as a science elective at Classic City High. The entomology class at the high school learns about the hives through a lecture from a specialist at the University of Georgia Bee Lab. The students work and manage the hives with help from the bee specialists. The apiary is used as a learning tool for both institutions in the field of biology and other sciences as well as for business, economics, and entrepreneurship classes. Honey and wax will be collected and sold to the community to

help provide income to fund various high school projects and to sustain the colonies.

Classic City High outdoor classroom service-learning project

Spring 2007 Entomology Outreach and Service-Learning students partnered with UGA courses in art education, horticulture, and environmental design and students at Classic City High School to create an outdoor classroom at the high school. Outdoor classrooms can become transformational learning spaces where students can understand the dynamics of community action and collaboration by cocreating a garden that enhances the learning community. Gardens are creative spaces that provide opportunities for interdisciplinary, inquiry-based education designed to encourage direct learning through observation, investigation, and hands-on activities. The outdoor classroom is a space for a number of disciplines to come together, work collaboratively, and learn by doing as they create something with lasting impact.

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In spring 2007 fifteen undergraduates and one high school student participated in Entomology Outreach and Service-Learning. All participants attended weekly class sessions, including the high school student who, although not formally registered, attended all classes on campus at UGA. All participating students at UGA and the high school attended an outdoor classroom planning session at Classic City High to get introduced to their project partners and to see the proposed project site. Gardens specifically created to attract butterflies and other insects may lead to increased fauna, flora, and biodiversity of the outdoor classroom by providing natural sources of food and habitat for arthropods as well as good sources of pollen for the existing bee colonies.

Results

In an effort to understand the impact or success of the university/high school service-learning projects, focus groups with the high school students and teachers as well as the university faculty and staff were conducted. Through these focus groups, several

needs were determined. The specific needs and concerns identified by the high school students were to involve them in the preplanning stage of future service-learning projects and to have better coordination and communication between UGA and Classic City High for all service-learning projects. The needs and concerns identified by the high school teachers included developing a service-learning resource guide with reference materials for before, during, and after a service-learning project, including reflection, evaluation, implementation, and outcomes. A second need identified by teachers was to organizationally identify needs for future service-learning projects. Future needs-assessments are recommended for high school students to show what their ongoing interests are.

The needs identified from the UGA focus group with faculty and staff were again a resource toolbox with examples of reflection, outcomes, assessments, evaluation, orientation, and problem-solving, as well as rubrics for evaluating or grading reflections and journals. Each of these needs was addressed by creating a resource toolbox of service-learning materials (pre, during, and post) utilized primarily by Classic City High and UGA faculty and staff. Selected excerpts from the focus groups follow:

Focus groups with Classic City students

- "Entomology isn't something people normally do. I have an interest in forensics as a career, may help shape that decision. I got to learn about entomology and now want to keep going to school for it."

Focus groups with Classic City teachers

- "Experiences are meaningful for the students."
- "Students are learning life and organizational skills."
- "Wonderful opportunity for professional development."
- "Means of connecting classes with students."

Focus groups with UGA students

- "With service-learning you learn as you go, apply team work skills, and it is reciprocal, we carry on and pass on information by putting it into application."

Focus groups with UGA faculty/staff

- "Way of networking on campus and the community, professional development opportunities with a true interdisciplinary approach."

Reflection activities were utilized throughout the semester as an ongoing formative evaluation and assessment of students enrolled in Entomology Outreach and Service-Learning. Students were asked to participate in two reflection exercises at four and ten weeks into the semester. Approximately four weeks into the class, students are asked to complete a "one-minute paper." The students have one minute to write a question or comment about the course or express a concern. This has been shown to be a very effective formative evaluation because it exposes ongoing and underlying questions or concerns that the students, for various reasons, have not found answers to. Student responses, which are anonymous, are collected, read aloud, and discussed. During these discussions, students often indicate that they were wondering about the same thing or had common concerns. The one-minute time limit also encourages the students to write about the first thing that comes to mind. Selected excerpts from the one-minute paper evaluation follow:

One-Minute Paper

- "I feel that our service-learning efforts are an incredibly valuable asset for the Athens community. I wish more major classes did service-learning in order to help the greater good of Athens."
- "Service-learning is progressive because it makes students want to learn so they don't seem ignorant when presenting insect information to a large class. I want to seem prepared and educated."

The one-minute paper responses reflect three results of this class. First, students are learning entomological science content by participating in the various educational entomological outreaches and through the service-learning project with Classic City High. Next, students are also learning about service-learning as a pedagogy and are already are seeing its usefulness and potential benefits for the community and for themselves. Finally, students are beginning to think about logistics, communication, and program planning and design in relation to the outreaches and the service-learning projects. Having experienced the complexities of working with multiple groups simultaneously toward achieving a common goal is an excellent mechanism for building future leaders and learners.

A second formative evaluation that is utilized as an ongoing assessment for students in Entomology Outreach and Service-

Learning during the semester is a reflection activity titled "One Good Thing, One Bad Thing." Approximately ten weeks into the semester students are asked to write down one good thing and one bad thing about the service-learning course, their personal outreach experiences, or the service-learning project for that semester. This is also a great opportunity to address student concerns about the course or to give students an opportunity to reflect about something positive. However, requiring the students to think about both the good and the bad encourages them to look at certain issues through multiple lenses or with different perspectives. Selected excerpts from the "One Good Thing, One Bad Thing" evaluation follow:

One Good Thing, One Bad Thing

- "Good: We're really helping the community and opening their eyes to entomology."
- "Bad: We don't have enough specific time slots for big outreaches so that lots of people can attend them."
- "Good: Public knowledge about insects is increasing at each outreach we attend. As the knowledge base grows so does respect for insects and overall concern about things crawling beneath our feet."
- "Bad: We should extend our outreach to other areas. I feel that Athens is very well covered."

These student reflections highlight many of the same attitudes and behaviors that the one-minute paper reflection exercise did, but these reflections appear to have greater depth. Students are now commenting on things such as communication breakdowns, more thoughtful organization in relation to actual experiences, and a larger understanding of "community" and thoughts about "public knowledge." Another theme is the apparent transition from learners to teachers. Students at this point in the semester (approximately ten weeks) have taken ownership of the outreaches and are fully responsible for leading the groups and teaching community members. Students feel they are educating the community about insects and science as well as seeing people being affected by their direct interactions. Also,

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the students themselves are learning more about insects through teaching and are challenging personal fears and ignorance.

Discussion

These service-learning projects have many measurable and unmeasurable outcomes. Excerpts from students' final reflective summaries provide insight into changes in their perceptions as a result of Entomology Outreach and Service-Learning.

- "My stereotypes of at risk students have changed."
- "I thought drop outs were just lazy. Many of these kids have had extremely difficult lives. I can't imagine dealing with school, having to support a family, living in poverty and having no transportation, but these kids are succeeding."
- "I felt like I was a part of something bigger, much bigger that is going to truly make a difference in people's lives."

These reflections indicate that the undergraduate students participating in Entomology Outreach and Service-Learning had a change in their attitudes toward at-risk students and high school dropouts. Students also indicated that the collaborative experience of working with various disciplines and types of students (high school, undergraduate, and graduate) was beneficial and something that many of them have not experienced before. It can also be inferred that students experienced a sense of community or being a part of something much bigger. This was a transformative experience for students who had never interacted with high school dropouts and were inspired by their willingness and desire to succeed. In the outdoor classroom and apiary a number of disciplines can come together, work collaboratively, and learn by doing as they create something with lasting impact.

Insect Natural History in Costa Rica: International Service-Learning, ENTO 3140

There is increased interest in and emphasis on study abroad experiences for students at colleges and universities in the United States. The number of American undergraduates who study abroad has increased significantly in the last decade *(Carlson et al. 1990)* as students tend to think that world experiences like these will offer them an edge in the increasingly competitive job market. In the last decade, calls for internationalization of higher education curricula have increasingly turned universities' attention to study-abroad programs *(Pickert 1992)*, as it is believed that a curriculum with an

internationalized scope broadens the subject matter and challenges students to develop cultural knowledge, increase foreign language awareness, and receive an enriched educational experience that may only occur once in their college careers.

Service-learning in an international context has been the topic of numerous publications across disciplines. Annette *(2002)* examined the extent to which higher education institutions contribute to the development of a global civil society and assist local communities in having a democratic voice in the process of globalization.

Internationalizing university curricula is a powerful and practical way of bridging the gap between rhetoric and practice *(Leask 2001)*. Many instructional strategies have surfaced to address the diverse needs of the learner. With this has come a desire to make education an ever-changing, lifelong experience showing relevance to the student's life; it has also allowed the growth of academic interest in experiential styles of education, which link the student with the community *(Cantor 1995)*. When using experiential learning to design an educational environment, Jeffrey Cantor states that "it is not uncommon to read reports of students working in community-based organizations and clinics in forms of service-learning" *(2)*.

According to Ash and Clayton *(2004)*, dissonance is a common emotion for participants in such situations. Students should be prepared for the service-learning experience by participating in an orientation where many of their own assumptions are challenged and participants are made aware of potential cultural, gender, or residential differences they may experience during the project. Even with orientation, however, many students may experience dissonance, confusion, uneasiness, or disconnect with the other participants or their community group. Examples of "during" service-learning reflection may involve community exploration; research activities; check-in/check-out; one good thing, one bad thing; informal spontaneous discussion; interaction with group, facilitator, and the local community; or community presentations and dialogues.

In 2001 UGA purchased a farm in the San Luis Valley of the Monteverde region in Costa Rica. A fully operational campus has been developed on this site. UGA Costa Rica offers interdisciplinary, field-based learning opportunities and cultural immersion in a tropical cloud forest environment. In fall 2005, UGA opened the Costa Rica Office on campus in Athens to promote and recruit students to participate in study abroad programs in Costa Rica

(UGA Costa Rica 2008). I felt that the presence of a UGA campus in Costa Rica represented a great opportunity to develop and implement an entomology study abroad course.

The following paragraphs discuss results of a research study on aspects of an international service-learning study abroad course titled Insect Natural History in Costa Rica: International Service-Learning, which involves university students, local high school students, and teachers throughout Georgia learning about insect natural history in Athens and in Costa Rica. The purpose of this study was to understand if an entomology study abroad service-learning class could be developed and implemented, as well as to assess the course and evaluate its effectiveness.

Methods

During summer 2006, the first entomology study abroad course at UGA was offered, Insect Natural History in Costa Rica: International Service-Learning (ENTO 3140-3140L). Six undergraduates and one recent high school graduate from our partner school, Classic City High School, participated in this class. During summer 2007, five undergraduate students, one graduate student, one high school student, and one high school entomology teacher, both from Classic City High, participated in Insect Natural History in Costa Rica. In summer 2008, ten undergraduates and one graduate student participated in the course. Four teacher interns participating in the Georgia Interns and Fellowships for Teachers (GIFT) program (two elementary school teachers and two high school teachers) also traveled to Costa Rica and participated in all aspects of the course.

Total participation in this three-year research study consisted of thirty participants: Twenty-one undergraduates, two graduates, one high school student, one high school graduate, and five K-12 teachers. There were seventeen males and thirteen females. All thirty students agreed to be participants in this study and indicated this agreement by signing a consent form the first day of class. This form requested permission for us to use their journal entries and written assignments and several in-class reflection activities as data. Participation in the survey was voluntary and students' grades were not affected by their participation.

This course was divided into three different components. In this hybrid course combining on-campus instruction and fieldwork, the first part of the semester was spent in Athens discussing background entomology, insect-collecting techniques, and cultural information the students would need when they arrived in Costa

Rica. This on-campus introduction was followed by an extensive laboratory field component, including approximately seventeen days in Costa Rica. The Costa Rica portion focused on two primary habitats, tropical wet forests (La Selva, Organization for Tropical Research Field Station near Puerto Viejo) and cloud forests (UGA Costa Rica Campus near Monteverde). The third component of the course is service-learning. During this research study, students participated in both direct and indirect service-learning projects. Specific projects for the three-year study will be discussed in detail below.

Results

The summer 2006 students were required to prepare a properly mounted ordinal-level insect collection. In addition, students were assessed based on their ability to communicate knowledge of tropical insect natural history and behavior in written periodic reports. The summer 2006 service-learning projects were indirect. Students' insect collections were donated to the UGA Costa Rica campus, to two Costa Rican schools in the San Luis area, to the Classic City High School, to the Institute of Biodiversity (INBIO) in Costa Rica, and to the Insect Natural History Museum at UGA. Another indirect service-learning project included students presenting their collections and giving brief introductions to various insect orders found in their collections to the other UGA Costa Rica groups on campus at that time.

Summer 2007 students were required to develop and implement a field project that examined some aspect of entomology in a temperate environment (Athens, Georgia) and compare it to a similar short-term study in a tropical environment (San Luis, Costa Rica). In addition, students were required to prepare a collection of beetles at the familial level. Representative samples of the insects were donated to local Costa Rican schools, INBIO and UGA Costa Rica, and Classic City High School, to foster a greater appreciation for these animals. A final course requirement was participation in a service-learning project teaching entomology in Costa Rican schools.

The summer 2007 service-learning component was much more defined. Students visited two Costa Rican schools and presented a lecture and discussion about the basic anatomy of an insect, participated in an arts and crafts period, played insect-related games, went on an insect-collecting trip around the school, and demonstrated a live insect zoo.

The 2008 study abroad program added a course in ornithology. Insect and Bird Natural History in Costa Rica: International Service-Learning was a combination of Insect Natural History (ENTO 3140/3140L) and Field Ornithology (FORS 4060/6060-4060L/6060L). A second addition in 2008 was participation by undergraduates from the UGA Griffin and Tifton campuses. Although these students are UGA students, this was the first time we had students join us from our branch campuses.

The four K-12 teachers hosted supply drives at their respective schools and gathered donations of school supplies to donate to the two elementary schools that we had worked with the previous year, Alto and Bajo San Luis Elementary Schools.

The indirect service-learning project was the donation of student insect collections to the teacher participants for their respective schools across Georgia. Of the eleven insect collections created by students, eight were voluntarily donated to the teachers. This willingness of UGA students to contribute to Georgia K-12 classrooms without being asked indicates that a mutual understanding of and admiration for education due to this experience transcends the physical collections and will hopefully be captured throughout Georgia classrooms for years to come.

Discussion

Insect Natural History in Costa Rica was successfully developed and implemented and is regularly offered each summer. Science education is rarely offered in most rural Costa Rican schools. One Costa Rican teacher commented on how beneficial it was for the students to see insects as an important part of their world instead of something to "just step on." Through the service-learning experience, UGA students were able to apply the knowledge of insects they had learned from the course, including names (both English and Spanish) of the insects they were collecting with the Costa Rican children, and to share some of their natural history, including habitat and food sources. UGA students also benefited from this interaction with Costa Rican children by learning Spanish and being able to effectively communicate science and information about insects to them. UGA students were able to teach Costa Rican children firsthand in a Costa Rican school. The program benefited the Costa Rican students through exposure to insects and science while simultaneously enhancing the educational experiences and cultural awareness of UGA students. An enlightened view of entomology allows both UGA and Costa Rican students to contribute more informed decisions to their communities

in regard to ecology, conservation, the environment, and food production. Students participating in the course were exposed to a vastly different environment in Costa Rica compared to that at UGA in Athens with respect to not only the physical environment (tropical rainforest and cloud forest) but also the cultural environment. Through interaction and collaboration with local residents and their children in collecting tropical insects and exploring specific microhabitats (e.g., carrion-feeding insects), UGA students participated in a truly enriching experience. Their perspective on the world was possibly enhanced in multiple new dimensions, and they are better prepared to prosper in our rapidly changing global society.

Conclusion

The absence of publications about service-learning in entomology established the justification for the current research project. In 2006, two service-learning courses were created in the Department of Entomology at UGA, Entomology Outreach and Service-Learning (ENTO 3900) and Insect Natural History in Costa Rica: International Service-Learning (ENTO 3140-3140L). The purpose of this study was to develop, implement, assess, and evaluate service-learning in entomology. Ultimately, this research provided findings about the capacity of service-learning in entomology, both locally and abroad, to influence students' views, attitudes, and behaviors regarding civic engagement, teaching and learning, and about how these changed views are associated with academic achievement and the various components inherent in service-learning courses that are significant in bringing about desired outcomes.

The findings from this assessment and evaluation of the impact of Entomology Outreach and Service-Learning on college student participants ultimately point to three outcomes: increase in entomological science content, more civic awareness, and interpersonal growth. It is evident that by the end of the semester these students are knowledgeable about basic insect science, can site-identify common insects, are familiar with natural history, are knowledgeable about maintenance and curation of live and preserved insects, and are aware of collecting and handling techniques. Through participation in the outreaches and the service-learning projects students seem to get a sense of their role in society and to see their interactions and behaviors through a different context. Students also seem to grow as individuals through interpersonal skills such as team building, collaborative learning, time management

and creativity, risk taking, persistence, meticulousness, ethical or social consciousness, empathy, cultural sensitivity, and social responsibility.

This interactive approach to building the apiary and the outdoor classroom will promote empowerment among the students and staff at the Classic City High School, thereby ensuring the long-term sustainability of this facility. Service-learning was an integral component of the course, including student participation in the idea generation and collaboration phase of planning the apiary and the outdoor classroom through continuous ongoing dialogue and open communication with the project partners and the high school. Another service-learning component engaged the high school and UGA students in community outreach programs in the Athens area and the annual Insect Zoo.

Insect Natural History in Costa Rica has been successfully developed and implemented, and is a sustainable study abroad program offered annually. The entomology service-learning course in Costa Rica has resulted in benefits for all participants, including undergraduate and graduate students, high school students, and K-12 teachers as well as the Costa Rican community through public outreach and community engagement experiences. According to a study done by Vogelgesang and Astin *(2005)*, an outcome of service-learning among college students is the sustainable development of civic engagement. Students participating in the Costa Rican outreaches were able to interact with a community arguably different from their own, learning about the community and responding to a specific need it held. Actively working to meet specific needs in the community may translate into active roles of civic engagement later *(Billig and Eyler 2003)*. The students of the Costa Rican schools may have also gained a better ability to maintain civic engagement. Scientific education in most rural Costa Rican schools may be missing at times and lacking at best. An enlightened view of entomology may allow these students to contribute more informed decisions to their communities in regard to ecology, conservation, and even crop production.

"Students participating in the Costa Rican outreaches were able to interact with a community arguably different from their own, learning about the community and responding to a specific need it held."

Future research will include additional assessments of students enrolled in service-learning classes; however, better-defined indicators are needed. Attitudes of students in service-learning classes should be compared with attitudes of students not in service-learning classes across various disciplines to give insight into the true effect of service-learning on predetermined behaviors. There is also a need for additional research and ongoing evaluations of our service-learning partnerships and projects.

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- Ray Noblet is professor of entomology and has been head of the Department of Entomology since 1997. In addition, he is professor of environmental toxicology in the UGA Interdisciplinary Toxicology Program. During his career, he has taught courses in medical entomology, general entomology, and ecotoxicology, as well as a variety of graduate seminar courses. Professional interests include vector biology and transmission of disease agents by insects, biological control, environmental toxicology, and biological assessment of environmental quality. Graduate education continues to be a major component of his research program activities. His research program at UGA continues to address biological control of vectors of human disease and use of aquatic insects to assess stream quality and watershed health.