An Undergraduate Summer Research and Mentorship Experience for Underrepresented Students in the Agricultural Sciences[1]

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Abstract

Women, Native Americans, and other minority groups have historically been underrepresented in the agricultural sciences. The objectives of this program were to: 1) create and administer an undergraduate student research internship and mentorship program in the agricultural sciences; 2) increase the number of underrepresented students in agricultural science majors at Little Big Horn College, Sheridan College, and the University of Wyoming; and 3) conduct pre- and post-survey evaluations for undergraduate student participants. Undergraduate students in Wyoming and Montana were recruited and hired by an advisory group of faculty from each institution and local agricultural industry representatives. Students were assigned faculty mentors to supervise and assist interns with an agricultural science research project. Mixed methods analysis was used for student and program assessment via collection of quantitative and qualitative survey data. After completing the program, students reported an increased knowledge of agricultural science and research. In addition, the research and internship program was successful in exposing underrepresented students to the world of agricultural science and research and in recruiting them into agricultural science academic programs.

Introduction

Academic agricultural science programs require students who are technologically advanced with knowledge of the both the basic and applied sciences (Goecker et al., 2005). There is a need for the agriculture industry to recruit gifted and knowledgeable college graduates to fill vital agricultural industry positions. Therefore, it is critical that agricultural colleges and universities recruit, retain, and graduate gifted and knowledgeable students who major in agricultural disciplines and pursue careers in the agricultural sciences.

Undergraduate research experiences can help students to understand and implement the scientific method, develop fundamental research skills, and work collaboratively with students, staff, and faculty mentors (Grossman et al., 2010; Lopatto, 2008; Taraban, 2008). Coker and Davies (2002) administered a survey to the American Society of Plant Biologists asking six broad questions concerning undergraduate research and three questions concerning high school student research. They found that when researchers used undergraduates and high school students in the research laboratory, students would: generally be interested in learning more about plant biology, ask for assistance in career choices, have greater motivation to pursue graduate education, be more likely to co-author a published research paper, be trained in laboratory research techniques, and reinforce classroom learning. Krasny (1999) discussed high school student research and the importance of recruiting targeted students, providing a quality research experience, student understanding of the research process, gaining support of university researchers, and building the long-term sustainability of a high school research program. Cannon et al. (2006) surveyed students who participated in the Virginia Governor's School for Agriculture program for gifted and talented high school juniors and seniors. The Virginia program provided hands-on, cutting edge, scientific and academic instruction to gifted and talented high school students in order to develop their understanding of agriculture, human health, natural resources, and veterinary medicine. The researchers concluded that the Virginia program was successful and could be used as a recruiting model by exposing high school students to agriculturally related university programs and majors. Undergraduate student participation in summer internship programs are valuable and can assist students in obtaining a job or position after graduation (Fenwick and Gartin, 1990).

In addition to experiential learning, faculty-to-student mentorship is also important to the academic and career success of agricultural science undergraduates (Retallick and Pate, 2009). While mentoring in an academic setting has routinely occurred during student advising and teaching sessions, students can benefit from a more focused and specialized mentoring environment (Woirhaye and Menkhaus, 1996). Retallick and Steiner (2009) report on the

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Science With Practice program which provided undergraduate students an opportunity to gain practical experience working with a faculty mentor in an agricultural university research environment. Project participants were surveyed after completing the program and were reported to have gained valuable research experiences that enhanced their undergraduate academic careers.

In 2004, only 8% of bachelor degrees in the agricultural sciences were earned by minorities (U.S. Census Bureau, 2005). This is less than half of the parity line mark of 31% in the 18-24 year old U.S. population receiving bachelor degrees. In addition, minority students earn less than 10% of the awarded doctorate degrees in the U.S. However, minority students currently represent about 25% of U.S. college and university populations. Women have historically been underrepresented in the agricultural sciences (FAEIS, 2005). Therefore, organizations such as the National Science Foundation, the National Institutes of Health, and the United States Department of Agriculture (USDA) have funded undergraduate research internship and/or mentorship programs with emphasis to increase the number and competiveness of underrepresented students in the sciences.

The objectives of this program were to:

1. Create and administer an undergraduate student research internship and mentorship program to recruit students into the agricultural science majors at Little Big Horn College, Sheridan College, and the University of Wyoming;

2. Increase the number of underrepresented students in the agricultural science majors at Little Big Horn College, Sheridan College, and the University of Wyoming;

3. Conduct pre-survey and post-survey evaluations for each undergraduate student research intern participant through qualitative and quantitative data collection.

Project Area and Institution Descriptions

This project involved collaboration between Sheridan College (SC), located in Sheridan, WY; Little Big Horn College (LBHC), located in Crow Agency, MT; and the University of Wyoming (UW) Agriculture Experiment Station (AES) Sheridan Research and Extension Center (SREC), located in Sheridan, WY. Sheridan College and the UW SREC are located 25 miles south of the Crow Indian Reservation, and 60 miles south of LBHC. Wyoming is the 10th largest state by area in the U.S. (253,337 km2), but ranks as the 50th largest state in the U.S. in terms of population (532,668 residents). The SC, LBHC, and the UW SREC campuses are isolated in rural areas with the nearest small urban areas of Billings, MT and Casper, WY located approximately 120-150 miles away. Therefore, the overwhelming majority of students entering SC or LBHC are local students living within a 150 mile radius, thus making student recruitment efforts critical to the sustainability of regional agricultural science programs.

The SC Agriculture program offers instruction, certificates, the Associate of Applied Science degree, and the Associate of Science degree in agricultural science, agricultural business, horticulture, and food and meat science. Little Big Horn College is a public two-year tribal college chartered by the Crow Tribe and is a 1994 Land-Grant College. Little Big Horn College initiated an Associate of Science in Agriculture degree program in 2006 focusing on animal science and range management and also offers an Associate of Science in Science degree focusing on tribal natural resources and environmental science.

The goal of the SC Agriculture Program is to recruit, retain, and graduate 20 students majoring in each major discipline of agricultural science, agricultural business, horticulture, and food and meat science. Prior to the student internship and mentorship program, the SC Agriculture Program was not meeting the goal enrollment in the Agricultural Science Program and enrollment was particularly low in the Agricultural Science, Food and Meat Science, and Horticulture Programs.

At the beginning of the student internship and mentorship program, there were a total of 46 declared majors in the SC Agriculture Program. Of these student's declared majors, 20 listed agricultural business, 12 listed agricultural science, seven listed food and meat science, and seven listed horticulture. While the agricultural business program is at goal enrollment, the SC Agriculture Program currently sits at 58% of the total declared major goal of 80 students. Agricultural business was at 100% of goal enrollment, agricultural science was at 60% of goal enrollment, food and meat science was at 35% of goal enrollment, and horticulture was at 35% of goal enrollment. Therefore, efforts were needed to increase the number of students entering into the low enrollment agricultural science degree programs.

The goal of the LBHC Agriculture Program is to recruit, retain, and graduate twenty students majoring in agricultural science. The LBHC Agriculture Program was first offered during the fall 2006 semester with a beginning enrollment of four students. Prior to the student internship and mentorship program, the LBHC Agriculture Program was at 20% of goal enrollment. The LBHC also offers an Associate of Science in Science degree focusing on tribal natural resources and environmental science with a goal of 20 declared majors. There were eight students listing tribal natural resources and environmental science as their declared major. This equaled 40% of goal enrollment for the AS degree in tribal natural resources and environmental science option. There was a need for student recruitment and retention for the LBHC Agriculture Program.

The UW Agriculture Experiment Station goals are to provide the following: an agricultural system that is highly competitive in the global economy, a safe and secure food and fiber system, a healthy and well-nourished population, a greater harmony between agriculture and the environment, and enhanced economic opportunity and quality of life for the public. The UW SREC conducts research and extension programs under the direction of the UW SREC Director and UW faculty and academic professionals in the Departments of Plant Sciences, Animal Science, and Renewable Resources focusing on forage crop production, horticulture, and environmental science.

Program Description and Methods

An Advisory Committee consisting of the Program Director, the co-Program Director, one faculty from SC, one faculty from LBHC, and one faculty from UW was created at the beginning of the program. The Advisory Committee interviewed student applicants, evaluated student intern performance, and monitored student research project progress. The goal was to hire approximately five high school juniors, seniors, or incoming college freshman students during each of the two summers for a total of ten student research interns. Once hired, the students were assigned to a UW agricultural science faculty mentor and a UW graduate student mentor. The faculty mentors directed and supervised the intern throughout the duration of the summer internship. With assistance from their faculty and graduate student mentor, the student interns created and submitted a brief proposal for their summer research project to their faculty mentor. In addition to their research project, student interns were responsible for submitting a weekly work log detailing their weekly research and work progress to the Program Director. Students attended regular training sessions to help prepare them for their academic careers. These interactive training sessions included: personal responsibility, teamwork, leadership, personal financial responsibility, research ethics, developing oral and poster presentations, agricultural entrepreneurship, and agriculture and world hunger. At the conclusion of the internship, student interns were responsible for submitting a final research report to the Advisory Committee. Also, the student interns were responsible for creating a poster or oral presentation to present their research findings to the Advisory Committee and other invited faculty, students, and guest at the student research symposium at Sheridan College. Student interns were encouraged to compile their research finding into a print article for submission to a scientific journal, trade magazine, or other publication. Student interns were also encouraged to travel to at least one national meeting to report on their research findings. Lastly, the student interns all completed a field trip to Sheridan College to tour the campus, classrooms, and facilities.

A mixed methods approach (Creswell, 2008) was used where both quantitative and qualitative data was collected and analyzed to evaluate participant's perception of the program (Plano Clark, 2010). The student interns (n = 27) were given identical pre and post-internship survey assessing the student's level of knowledge and attitudes of agricultural science and the effectiveness of the internship program on their future academic and career choice. Undergraduate students (n = 29) who were not hired and did not participate in the internship and mentorship program were also pre-surveyed. The survey instrument used in this work was based upon the instrument developed by Dyer et al. (1996). The surveys collected both qualitative and quantitative data through the use of descriptive survey questions, Likert-type scale questions (where 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = strongly agree), and open-ended questions where students were able to give open, non-guided responses. Quantitative data was analyzed using SAS 9.1 software (SAS Institute, Cary, NC) using PROC CORR and PROC GLM. Reliability of the survey instrument was determined by estimating internal consistency by computing Cronbach's Alpha (0.73). Qualitative data was collected similar to the assessment techniques of Klein et al. (2007) in their evaluation of a service learning and mentoring program through journaling and interviews. Qualitative data was recorded by participants through completion of weekly work log journals. At the completion of the internship program, participants were interviewed and responded to open-ended questions where they were free to give non-guided responses to assess their perceived effectiveness of the program and their expected academic goals. Qualitative data was analyzed by merging results via discussion through corroboration or divergence with quantitative data (Creswell and Plano Clark, 2007). This study was deemed exempt under federal regulation 45CFR §46.101(b) (U.S. Department of Health & Human Services, 2009).

Results and Discussion

Descriptive Results

A total of 27 student interns participated in program from of 2006 to 2008. Five students participated in 2006, eight students participated in 2007, and 14 students participated in 2008. Fifteen students were female and 12 students were male. Four students identified themselves as Native American, 22 students identified themselves as Caucasian, and one student identified themselves as Hispanic. Seven students were high school juniors, nine students were high school seniors, and 11 students were college freshman. Participant's cumulative high school GPA ranged from 1.4 to 4.0. Twenty-three of the students had completed the ACT exam at the time of their internship with scores ranging from 18 to 32. Fourteen participants reported that had never taken agricultural classes during high school while 13

participants reported that they completed at least one agricultural class during high school. Twenty-nine students who did not participate in the student internship program were also surveyed and served as a non-participant pre-survey group. Of these 29 non-participants, eight worked at the UW SREC as part-time student workers and 21 applied for the internship program, but were not hired.

Quantitative Results

A pre- and post-survey was given to each student internship and mentorship program participant, as well as non-participants that were not hired for the program, to assess their perceptions of agricultural science. There was no significant difference between student internship and mentorship program participants and non-participants responses for quantitative data in the pre-survey (data not shown). There was a significant difference between student internship and mentorship program participant's pre- and post-survey results (Table 1). After completing the summer internship and mentorship program, student interns mean responses changed from "uncertain" to "strongly agreed" that "agriculture is a scientific area of study" and "agriculture is a blend of scientific principles and agricultural practices." Student intern participants mean responses changed from "uncertain" to "agreed" that "studying agriculture is important." Both pre-and post-survey results indicated that participants disagreed with the statement that "only students with farm backgrounds should pursue careers in agriculture." Since there was no significant difference between participant and non-participant pre-survey results, but there was a significant difference between pre- and post-survey results, it can be concluded that participant's perception of agriculture and agricultural science changed after completing the internship and mentorship program (Table 1). These results are similar to those reported by Grossman et al. (2010) whereby students who participated in an agroecology summer experiential learning program reported increased knowledge, skills, and interest in sustainable agriculture research and careers after completing the program. Similar summer research and internship programs could have great potential to recruit students into agricultural science degree programs and careers.

Table 1. Summer Research Internship and Mentorship Program Participants (n = 27) Perceptions of Agriculture before and after Completing the Internship Program

Statement	Pre-internship results		Post-internship results	
	Mean[z]	SD	Mean	SD
Agriculture is a scientific area of study.	3.5	0.9	4.7***[y]	0.5
Agriculture is a blend of scientific principles and agricultural practices.	3.5	0.6	4.7***	0.5
Agriculture is a highly technical field of study.	3.2	0.6	4.0***	0.5
The perception of agriculture is improving.	3.3	0.7	3.4 NS	1.0
Only students with farm backgrounds should pursue careers in agriculture.	1.9	0.8	1.7 NS	0.5
Studying agriculture is important.	3.5	0.8	4.2*	0.8

[z] Means are based upon a five-point Likert-type scale where 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = strongly agree.
[y] *, **, and *** indicate significance at P = 0.05, 0.01, and 0.001, respectively; NS indicates no significant difference.

Qualitative Results

The most common participant theme identified in the qualitative post-internship surveys and weekly work journals was increased knowledge of research and the science of agriculture. Many students noted that the favorite part of the internship program was being involved in research projects. For example, one student stated "I learned a lot about testing things, the scientific part of it," another stated "I learned a lot about horticulture and the science," while another stated "I liked the turf projects out at the Powder Horn and the equestrian center; I liked taking pictures and understanding the research out there," another stated "I really enjoyed the experiments up at the turf [sic], I really liked that, finding problems out and experimenting with things" and one student stated they liked "taking grass samples, water samples, and soil samples." This is supported by the quantitative results whereby student interns mean responses changed from "uncertain" to "strongly agreed" that "agriculture is a scientific area of study" after completing the summer internship and mentorship program.

Every student participant stated that they would recommend the internship and mentorship program to other students. Common student responses included "I would definitely recommend it," "It's a good work experience," "It is a really good program," "It was really cool," and "I would, especially if they thought they might like ag, to get a feel for it." However, students had several suggestions when asked for ideas to help improve the internship and mentorship program for future students. The most common theme was students wished they had more time to prepare and conduct their research project during the summer. Many agricultural science research projects take two or more years to complete, yet students were only hired to work for up to 12 weeks during the summer for this program. One student stated "It was really hard to juggle work time and research time" and another stated "I think we should

have more focused assignments because there is so much research being done here." Student participants in this program worked on several research projects in addition to their own, which likely contributed to the perceived lack of time and understanding during their research internship and mentorship experience. This corresponds with student assessment for an experiential learning project by Grossman et al. (2010) where mentored comparison group student participants also stated they did not understand all the research projects going on during the summer. For future projects, mentors should take measures to ensure that students have enough time to work on research projects and that they thoroughly understand the goals and objectives of any research project in which they participate.

Participant Tracking

At the end of the program, students were surveyed to assess whether they decided to pursue agricultural science majors in a college or university and a total of 14 students responded. Four student interns decided to attend SC and major in agricultural science. Four student interns decided to attend LBHC and major in agricultural science. One student decided to attend UW and major in agricultural science while one student decided to attend UW and major in engineering. One student decided to enter the military. The remaining three students were high school seniors and reported that they planned to attend college the following year. Of the three high school seniors, one plans to major in agricultural science at SC and the other two plan to major in premedicine at UW. Of the students who responded that they were attending a college or university and majoring in agricultural science, four are Native American (three females and one male), one is Hispanic (female), and four are Caucasian (four females).

Summary

This research and internship program was successful in exposing underrepresented students to the world of agricultural science and research. Of the 27 participants, 16 were from underrepresented groups. Fifteen female students, including three Native American students and one Hispanic student, and one Native American male student were able to participate in this program. Student participants reported increased knowledge of agricultural science and research and that they would recommend this program to other undergraduate students. Students also noted that they did not gain detailed knowledge of all research projects that they participated in during the summer and that they felt there was not adequate time to complete their research projects during one summer. Similar programs can be successful to expose students to agricultural science and research, but should properly plan to ensure that students are not overwhelmed by the research process. If students are asked to participate in several research projects, mentors should ensure that participants have an understanding of the goals, objectives, and related hypotheses of each research trial. Future undergraduate research internship programs should seek to engage students in research activities over a longer period of time (one year or more) rather than for just one semester or one summer. This approach could enable students to gain a thorough understanding of the research process and allow for a more detailed research internship and mentorship program.

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