Understanding How Research Experiences Foster Undergraduate Research Skill Development and Influence STEM Career Choice

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Abstract

Since 2000, the University of Florida's Institute of Food and Agricultural Sciences (IFAS) has offered summer research internships at its Florida Agricultural Experiment Station to encourage undergraduate students to engage in science-focused education and pursue STEM-focused careers. The internships have provided students an opportunity to acquire hands-on research experience while working one-on-one with faculty members conducting research across a variety of disciplines. The purpose of this research was to assess the impact of the research internship by examining the research skills students developed and the career trajectories they chose. When comparing reported research-related skill levels before and after participating in the internship there were statistically significant ($p \leq .01$) positive changes in all 19 indicators of research skills. The two highest areas of gain were practical skills for conducting research and knowledge of the important literature in their field. Other key skills acquired were those related to critical and logical thinking and the ability to synthesize information. In addition, 64% of the respondents attended graduate school and 69% reported they were currently working in a science-related field. Results of the study demonstrated that hands-on research experiences at the undergraduate level improved the participants' self-reported research-related skillset.

Introduction

Science, technology, engineering and math (STEM) occupations have become critical to the continued economic competitiveness of the United States (US) and graduates skilled in these areas are in high demand (Carnevale et al., 2011). While a demand for such workers exists, fewer students than the US economy currently demands are graduating with STEM expertise. The percentage of STEM bachelor's degrees granted has steadily declined from 35% in 1966 to 31% in 2008 (National Science Board, 2012). Given the increasing workforce demand for students with STEM backgrounds, STEM related internships might be beneficial in encouraging students who are considering the pursuit of a STEM degree. According to the National Association of Colleges and Employers (2011), "40% of new college hires will stem from internship and co-op programs."

The University of Florida's Institute of Food and Agricultural Sciences (IFAS) offers Research Internships to undergraduate students through the Florida Agricultural Experiment Station (FAES) each summer. The internship program is a cooperative effort between the College of Agricultural and Life Sciences (CALS) and the FAES. The FAES is the research arm of IFAS with a mission to discover, invent and develop applications of new knowledge in agriculture, human and natural resources. FAES faculty are based in various IFAS departments on the main campus in Gainesville and at research and education centers throughout Florida. The FAES has over 650 active research projects with specific goals and objectives led by faculty. The internship program places undergraduate students with a faculty member for a 6-week period during the summer to learn about an FAES Research Project and to contribute their knowledge to the research project. The internship program was initiated during the summer of 2000 with 11 participants. Over the years, the program has grown with 56 individuals participating during the summer of 2012. By the end of summer 2012, a cumulative total of 370 undergraduates from the College of Agricultural and

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Life Sciences had participated in a research internship through the FAES. Internship programs have been suggested as an effective way of providing students with meaningful experiences because of the direct and targeted impact they have on a students' professional development. An evaluation of the FAES program was performed to determine if it was meeting the objective of recruiting students into STEM fields and careers.

Learning experiences that are designed to intensely focus on preparing students for future careers can improve their confidence to enter those careers (Esterl et al., 2006). Students acquire concrete experiences from internships because they are taught using direct experiences relevant to their specific career interests (Morgan and King, 2013). They retain and apply concepts effectively when they learn through active experiences (Fosnot, 1996). In the scientific fields, research projects have been used to directly improve and inspire students' scholarship. Research projects that intensively engage undergraduate students can enhance their academic experience (Lopatto, 2004). Such projects inspire students to be part of the scientific community due to the relationships they form with faculty members (Hunter et al., 2007). These relationships provide students with opportunities for professional development, which in turn makes it possible for them to effectively transition from college to the workplace. Students that have participated in intensive internship programs may be more prepared to enter the workplace because they are psychologically prepared to navigate through new cultural expectations (Stitts, 2006). Internship programs may help graduating college students determine if a career of interest is appropriate for them, since these programs make it possible for students to clearly understand the expectations of specific careers (Neapolitan, 1992).

Through internships, students acquire specific career skills and work experience they could not acquire in a classroom setting (Alpert et al., 2009; Boger and Lim, 2005; Busby, 2003; Chi and Gursoy, 2009; Mello, 2006; Van't Klooster et al., 2008). Internships play an important role in bridging classroom experiences and practical career application (Ewing, 1973; Nevett, 1985). Through intensive internship projects, students are able to put into practice the theoretical knowledge they gained in the classroom (Busby, 2003; Cho, 2006; Lam and Ching, 2007; Walo, 2001). Sax (2001) stated "*carefully placing students in internships and mentorships is also an important mechanism for exposing students to ways in which scientific research goes beyond the abstract and theoretical by addressing societal issues and needs*" (p. 168). For example, a study of the outcome of an animal science internship program at the Ohio State University Agricultural Technical Institute, examining ten years of records, showed that students who participated acquired communication skills, improved creative thinking abilities, improved job interviewing and networking skills and improved self-confidence and leadership skills (Bennett-Wimbush and Amstutz, 2011).

Internships have also been shown to improve students' chances of securing employment in the career of their choice (Callanan and Benzing 2004; Knouse et al., 1999). This is because internships improve their career decision-making abilities (Brooks et al., 1995; Taylor, 1998) and equip them with skills that are relevant for the jobs they seek (Garavan and Murphy, 2001). Internships also develop other personal abilities that are essential for career advancement and are sometimes explicitly required by certain jobs, such as problem-solving skills, leadership and communication skills and interpersonal skills (Ruhanen et al., 2013). Gaining these skills may encourage students to apply for jobs they would not have applied for previously. They also enable students to have a competitive edge in the work place (Alpert et al., 2009; Boger and Lim, 2005) often leading to higher starting salaries (Coco, 2000; Gault et al., 2000), higher job satisfaction (Divine et al., 2007; Gault et al., 2000), more job opportunities after graduation (Coco, 2000; Divine et al., 2007) and improved job related skills (Divine et al., 2007; Knemeyer and Murphy, 2002).

Lastly, internships motivate undergraduate students to pursue further learning at the graduate level (Alexander et al., 1998; Bauer and Bennett, 2003; Hathaway et al., 2002; Karcher and Trottier, 2014; Lopatto, 2007; Tyler, 1971). Rigorous scientific research introduces students to the world of scientific research (Sadler and McKinney, 2010). By participating in internship programs, students acquire skills they can directly use for conducting research at the graduate school level and gain a deeper understanding of the literature in the field. Through engagement with the vast literature in their field and carrying out research, undergraduate students improve their intellectual curiosity (Bauer and Bennett, 2003) and are able to explore research questions on their own. Schowen (1998) found that most undergraduate students who participate in research programs in their universities pursue advanced studies in their fields. For some undergraduates, the research experience they get from an internship project may guarantee them successful admission to graduate schools. Kinkead (2003) notes that, "*undergraduate research projects can provide students with the coinage of the realm that ensures their admittance into prestigious graduate schools*" (p. 10).

Theoretical Framework

Kolb's (1984) experiential learning theory served as the theoretical framework for this study. This theory is appropriate because it "provides one of the few comprehensive and fully generalized models" (Kayes 2002, p. 140) of learning. The validity and reliability of the learning model based on the theory has been widely supported by extensive research (Hickox, 1991; Iliff, 1994; Kayes, 2002). The theory makes it possible for students to get an effective learning experience because of the four-stages its model is based on: concrete experience, reflective observation, abstract conceptualization and active experimentation (Cowan, 1998; Petkus, 2000). The concrete experiences students acquired through the four stages provide them with a firm foundation for observations that are integrated into generalizations and guide their interactions with the world around them (Loo, 2010). The model provides a structure for assembling techniques and strategies in a concrete format that can be used to systematically guide students that are undecided about future career choices (Atkinson and Murrell, 1988). It explains how experiences are translated into concepts that may guide student's active experimentation and their choice of new careers or educational experiences (Healey and Jenkins, 2007).

Experiential learning theory recommends an "*orientation toward teaching and learning that values and encourages linkages between concrete educative activities and abstract lessons to maximize learning*" (Warren, 1995, p. 239). Learning environments that apply the theory encourage students to directly apply what they are learning and then generalize the information outside the learning environment (Beard and Wilson 2006; Lamm et al., 2011). The experiential learning modes are based on activities that "*include cooperative education placements, practicum experiences and classroom-based hands-on laboratory activities*" (Cantor, 1997, p. 3). These activities help students "*reach new levels of cognitive, perceptual, behavioral and symbolic complexity*" (Chickering, 1981, p. 2). In addition, "*the experiential learning theory affirms the importance of experiential activities, such as fieldwork and laboratory sessions*" (Healey and Jenkins, 2007, p. 186). Since the theory emphasizes the importance of personal experience in future engagement (Baker et al., 2012; Kolb, 1984; Roberts, 2006), it is expected that direct engagement in a research experience would encourage students to think about using research outside of school, perhaps fostering efficacy to engage in a STEM focused career.

Methods

Data Collection

A researcher-designed survey instrument was used to identify (a) the research skills FAES internship participants developed during the six weeks they participated in the FAES internship program, (b) internship participants' career path after graduation and(c) details of internship participants' current employment status. To identify the research skills internship participants developed during the FAES internship program Bauer and Bennett's (2003) undergraduate skills and abilities scale was adapted to a retrospective pre/posttest design requesting respondents to identify their level of competence with specific research oriented skills on a 5-point Likert type scale. Open-ended questions were used to collect respondents' descriptions of career paths after graduation. A panel of experts reviewed the instrument for reliability and validity purposes. The study protocol was approved by the University of Florida's Institutional Review Board and all participants provided written informed consent prior to participation in the study.

Participants/Sampling

A list of the 370 FAES internship program alumni was gathered from paper records kept by the research internship program. University of Florida student identification numbers were used to connect past participants to University of Florida Alumni Association records to determine recent mailing addresses. The survey was distributed through the mail using Dillman et al., (2009) Tailored Design Method including a pre-notice, the mailed survey instrument and two reminders. A pre-notice letter was sent by the Dean's office to notify participants of the upcoming survey and its importance. One week later it was followed by the paper survey with a postcard reminder sent two weeks later. If a response was not received one month after the initial contact, a second paper survey was sent with one last reminder. In total, 142 participants responded out of the 370 contacted with a completed survey resulting in a 38% response rate. Demographic characteristics of respondents were compared to the entire alumni group to assess for differences and were found to be non-significant; therefore the respondents were considered representative of the population of interest.

Data Analysis

Respondents were asked a series of 19 statements in which they had to indicate how strongly they agreed or disagreed about the level of impact their internship experience had on their feelings about research and the role of the faculty mentor in fostering a positive research experience. Respondents were also asked if they took courses they had not previously considered, changed their major, or attended graduate school after completing their internship. Statistical frequencies for the questions were analyzed using SPSS.

Respondents were then asked to indicate their level of competence on the 19 research skills developed by Bauer and Bennett (2013) before and after their research internship experience. The before and after response items were scored on a 5-point Likert response from 1 = *No competence*, 2 = *Low competence*, 3 = *Somewhat competent*, 4 = *Competent* and 5 = *Highly competent*. Since the instrument was designed to indicate a single construct, research skills, all 19 items were averaged into an overall mean score. A dependent sample t-test was conducted to test the differences in responses both before the research internship and after. Differences in means with a p-value of 0.05 or lower were considered statistically significant.

Three open-ended questions were given to respondents regarding their career decisions after graduation. They were asked to describe their career path after they graduated, along with their current job title and the name of their current employer. Open-ended responses were grouped into themes and/or categories by the researchers using Weft QDA.

Demographic data were collected regarding student's academic major and academic class standing (freshman, sophomore, etc.) at the time of their internship, race and gender.

Results and Discussion

Demographics

Table 1 presents demographic information from the respondents. More female respondents (62.4%) participated in the internship program than male respondents (37.6%). The program primarily attracted upper level undergraduate students with 56.0% reporting they were juniors and 33.3% reporting they were seniors at the time of their internship. In general, a large percentage of the respondents were from STEM disciplines, although there were some from other disciplines. The STEM respondents represented a wide range of majors with a few being highly represented. A higher percentage of respondents represented the following majors: Animal Science (12.8%), Food Science and Human Nutrition (9.4%), Microbiology and Cell Science (7.9%), Family, Youth and Community Sciences (7.9%), Wildlife Ecology and Conservation (7.9%), Agricultural and Biological Engineering (7.2%), Environmental Science (7.2%), Food and Resource Economics (7.2%), Biology (6.5%) and Plant Science (5.8%). The majors highlighted above show there was a moderate percentage of students from non-STEM disciplines (such as Family, Youth and Community Sciences and Food and Resource Economics). The majority of students were White (66.2%), followed by African American/Black (23.7%).

Table 1. Demographics at Time of Internship

Demographic category	%
Gender	
Female	62.4
Male	37.6
Class Standing	
Freshman	0.7
Sophomore	9.9
Junior	56.0
Senior	33.3
Major	
Animal Science	12.8
Food Science and Human Nutrition	9.4
Microbiology and Cell Science	7.9
Family, Youth and Community Sciences	7.9
Wildlife Ecology and Conservation	7.9
Agricultural and Biological Engineering	7.2
Environmental Science	7.2
Food and Resource Economics	7.2
Biology	6.5
Plant Science	5.8
Natural Resource Conservation	5.0
Landscape and Nursery Management	2.9
Forestry	2.9
Other	9.4
Ethnic/Racial Category	
African American/Black	23.7
Asian	5.8
White	66.2
Other	4.3

Research Internship Experiences

A large number of employers within STEM related fields are likely to employ students that have participated in a STEM related internship program (National Association of Colleges and Employers, 2011); therefore it is important to ensure interns have the appropriate experiences to prepare them for future employment. In order to examine the perceived impact of the FAES internship program, respondents were asked a series of questions designed to gauge their level of agreement with statements associated with their research internship experience (see Table 2).

Over 90% of the respondents agreed or strongly agreed their internship helped them evaluate whether or not they would like to be a researcher and 89.4% agreed or strongly agreed their supervisors improved their knowledge on conducting scientific research. In addition, 75.9% of the respondents agreed or strongly agreed the internship improved their ability to critically think about research reported by the media.

Taken together, these findings confirm studies on internships that have shown they provide students with more insight for deciding the career they would like to pursue (Callanan and Benzing, 2004), improve their skills (Garavan and Murphy, 2001) and improve creative thinking abilities (Bennett-Wimbush and Amstutz, 2011). These results imply that the program improved participants' real world understanding of research. Participants also had positive experiences with the individual they worked most closely with during their internship. This is a positive outcome, since social interaction with faculty can encourage students to remain in their academic programs (Milem and Berger, 1997).

Table 2. Internship Experiences

Activity	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
The research internship helped me evaluate if research was something I wanted to do more.	2.1	3.5	2.8	26.2	65.2
The individual I worked with most closely during my internship experience was a very good source of quality information related to conducting scientific research.	2.1	3.5	5.0	28.4	61.0
The individual I worked with most closely during my internship experience helped me understand clearly what was expected of me during the internship.	2.1	2.8	9.2	28.4	57.4
The assigned faculty mentor for my internship was very engaged in my project.	4.3	2.9	9.3	27.1	56.4
The internship experience helped me think more critically about research reported by the media.	1.4	5.7	17.0	29.8	46.1

Skills Improvement after Internship Experience

One of the primary goals of the FAES internship program was to improve students' research-related skills. Respondents were asked to indicate their level of competence both before and after their internship experience with 19 research-related skills on a Likert-type scale with 1 = *No Competence*, 2 = *Low Competence*, 3 = *Somewhat Competent*, 4 = *Competent* and 5 = *Highly Competent*. Responses were examined individually and then summed and averaged to create an overall research competence mean score both before and after participating in the internship. When compared, there was a statistically significant positive change between the reported competency level before participating and after participating in the research internship. Table 3 shows the reported levels of competence before the internship, Table 4 shows the reported levels of competence after the internship and Table 5 shows the change in the overall research competence mean scores. Before the research internship, respondents scored an overall level of "somewhat competent" with an average score of 3.49. After the research internship, this score increased to the "competent" range, with an average score of 4.14. This change was statistically significant at the 0.01 level.

When items were reviewed individually, the largest areas of reported improvement in competence were in the skills for carrying out research and the knowledge of the science literature in their field. Before the internship, on average, respondents indicated an average score of "somewhat competent" in carrying out research and knowing science literature in the field, which increased to an average of "competent" after the internship experience. The skills that had the lowest level of change in competence were listening effectively, speaking effectively and writing effectively. Although the change was low, on average the respondents were already competent in these skills before starting the internship. The outcomes mentioned above show that the internship accomplished its main goal of improving students' research skills. These findings support other studies which have demonstrated the engagement in research as an undergraduate improves students' research related skillset (Lopatto, 2007; Seymour et al., 2004).

Table 3. Reported Competence in Research Areas before the Internship

Activity	NC[1] (%)	LC (%)	SC (%)	C (%)	HC (%)
Write effectively	0.7	4.3	23.7	51.1	20.1
Speak effectively	1.4	3.6	24.5	53.2	17.3
Listen effectively	0.0	1.5	21.9	54.7	21.9
Solve problems independently	0.7	2.9	40.1	44.5	11.7
Understand ethical implication	0.7	3.6	28.3	53.6	13.8
Understand scientific findings	0.7	18.7	40.3	36.0	4.3
Carry out research	7.9	28.1	49.6	12.2	2.2
Use statistics or math formulas	4.3	18.0	40.3	31.7	5.8
Know literature of merit in the field	8.8	29.2	44.5	16.8	0.7
Analyze literature critically	6.5	26.8	42.0	22.5	2.2
Maintain openness to new ideas	0.0	5.0	16.5	58.3	20.1
Place current issues in historical context	4.3	12.9	38.8	37.4	6.5
Work as part of a team	0.7	2.2	15.8	56.1	25.2
Adapt to changing technology	0.7	2.9	28.5	54.0	13.9
Think logically about complex material	0.0	4.3	45.3	38.8	11.5
Approach problems creatively	0.0	8.6	34.5	48.2	8.6
Synthesize and use information from diverse sources	0.0	12.2	37.4	44.6	5.8
Develop intellectual curiosity	0.7	4.3	34.1	48.6	12.3
Tolerate ambiguity	4.4	14.1	44.4	31.9	5.2

[1]NC = *no competence*, LC = *low competence*, SC = *somewhat competent*, C = *competent*, HC = *highly competent*

Table 4. Reported Competence in Research Areas after the Internship

Activity	NC[1] (%)	LC (%)	SC (%)	C (%)	HC (%)
Write effectively	0.7	0.7	12.1	55.3	31.2
Speak effectively	0.0	0.0	13.6	56.4	30.0
Listen effectively	0.0	0.0	6.5	53.2	40.3
Solve problems independently	0.0	0.7	5.7	55.0	38.6
Understand ethical implication	0.0	1.4	10.0	53.6	35.0
Understand scientific findings	0.0	1.4	9.9	51.8	36.9
Carry out research	0.7	0.7	15.0	48.6	35.0
Use statistics or math formulas	0.7	5.7	25.5	48.9	19.1
Know literature of merit in the field	0.7	10.0	20.7	42.9	25.7
Analyze literature critically	0.7	7.1	22.9	50.7	18.6
Maintain openness to new ideas	0.0	0.0	2.8	61.7	35.5
Place current issues in historical context	0.0	6.4	31.4	44.3	17.9
Work as part of a team	0.0	0.0	3.5	43.3	53.2
Adapt to changing technology	0.0	0.0	14.3	52.1	33.6
Think logically about complex material	0.0	0.0	9.9	52.5	37.6
Approach problems creatively	0.0	0.0	14.1	49.3	38.6
Synthesize and use information from diverse sources	0.0	0.7	12.8	51.8	34.8
Develop intellectual curiosity	0.0	0.0	7.2	43.5	49.3
Tolerate ambiguity	1.5	6.6	29.2	41.6	21.2

[1]NC = *no competence*, LC = *low competence*, SC = *somewhat competent*, C = *competent*, HC = *highly competent*

Post-Internship Educational and Career Choices

Two of the primary reasons the FAES research internship program was established was to encourage undergraduate students to engage in science-focused education and pursue STEM careers. In this regard, internships could play a significant role in filling the growing need for graduates with STEM degrees in the US.

Educational Choices

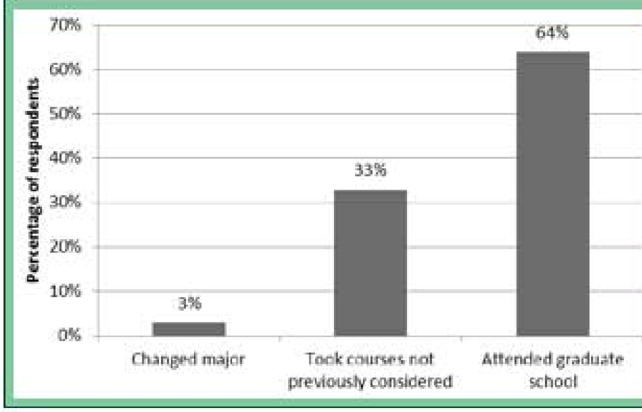
Respondents were asked a series of questions gauging their educational choices after completing their FAES internship experience. First, respondents were asked if they had enrolled in courses they had not previously considered, changed their major, or attended graduate school after engaging in the internship experience. After the internship experience, 33% of respondents took a course they had not previously considered. Most did not change their major (only 3% did) and the majority (64%) attended graduate school (Figure 1). Given that most respondents were either juniors or seniors, it is to be expected that most would not have changed their major. While it is unlikely, as well as difficult, to show that the research internship experience caused respondents to consider graduate school, research experiences can help validate students' prior interests in science, research and graduate studies (Seymour et al., 2004). Immersing oneself in a science research environment can help students evaluate their own career interests and whether they are a good match for the unique professional environment of research (Seymour et al., 2004).

Table 5. Mean Change in Research Competency Level Before and After Internship

	M Before (*SD*)	*M* After (*SD*)	*M* Change (*SD*)
Overall Research Competence	3.49 (.49)	4.14 (.45)	.66** (.45)[1]

[1]Mean change assessed through dependent *t*-test, ** $p \leq .01$.; Competency was assessed on a 5-point Likert-type scale of 19 total items with 1 = *No Competence*, 2 = *Low Competence*, 3 = *Somewhat Competent*, 4 = *Competent*, and 5 = *Highly Competent*.

Figure 1. Educational choices students made after completing the internship.



Career Choices

Finally, respondents were asked to describe their career path following graduation. Responses included open-ended descriptions of their career path, their current job title and employer and whether or not they are currently working in a science-related field. Respondents were asked to briefly describe their career path after they graduated with their bachelor's degree. The open-ended responses were categorized into four major career trajectories (see Table 6).

The types of employment noted by respondents were categorized into six different categories and included: (a) government or extension work, (b) business or engineering, (c) human services, including teaching, (d) environmental or outdoor type work, such as forestry or park ranger, (e) human or animal health, such as a doctor or vet and (f) working in research or in a lab. The types of graduate programs those currently in graduate school reported being involved in included: (a) pre-professional programs (such as M.D., D.V.M.), (b) Master's program, (c) Ph.D. program and(d) Unspecified graduate program.

Table 6. Career Paths Chosen after Graduating with a Bachelor's Degree

Career Paths	Number of Respondents (%)
Employed following graduation and still working	39 (35.8)
Attended graduate school immediately following graduation and still in graduate school	26 (23.9)
Attended graduate school after graduation and now currently working	25 (22.9)
Employed following graduation, now attending or applying to attend graduate school	19 (17.4)

Respondents that went directly from their bachelor's degree to employment were primarily those employed in business or engineering. Those who attended graduate school directly upon completion of a bachelor's degree were most likely to be currently working in the human or animal health professions (Table 7).

Table 7. Career Paths for those Currently Working

Career Path	Employed following graduation, still working (number of respondents)	Attended graduate school after graduation, currently working (number of respondents)
Business or engineering	12	3
Environmental/outdoors	7	5
Government/extension	6	4
Human or animal health	2	8
Human services	9	3
Research or lab work	3	2

Respondents employed following their bachelor's degree who later returned for graduate school were most likely to be enrolled in or applying to a Master's degree program (Table 8). Respondents who attended graduate school directly after completing their bachelor's degree were most likely to be currently enrolled in a pre-professional program.

Table 8. Career Path for those Currently in Graduate School

Career Path	Employed following graduation, now attending or applying to graduate school (number of respondents)	Attended graduate school after graduation, currently in graduate school (number of respondents)
Pre-professional program	4	13
Master's program	7	4
Ph.D. program	4	6
Unspecified program	4	3

Ten respondents reported they were still currently in their bachelor's degree program and had not yet graduated. Of these ten, five respondents plan on attending graduate school once they finish their bachelor's degree.

Current Employment

When asked, 69% of respondents reported they were currently working in a science related field. Respondents were asked to provide the name of their current employer. Their responses were grouped into major categories that can be seen in Table 9. The most common type of employer was a university (*n* = 26) followed by the government (*n* = 18).

Table 9. Current Employer

Current Employer	Number of Respondents
University	26
Government	18
Medical Company/Hospital	11
Agricultural/Natural Resource Company	9
Animal Company or Veterinarian	9
School (non-university) or Human Services	9
Private Company- Other	8
Self Employed	5
Unemployed	4
Technology Company	3

Table 10. Current Profession

Current Job Title	Number of Respondents
Student	19
Technician/Scientist	14
Teacher, Instructor, or Professor	10
Medical Doctor, Clinician, or Nurse	9
Engineer	6
Counselor or Therapist	5
Veterinarian	4
Research Assistant/Associate	4
Unemployed/Stay at home parent	4
Sales Manager or Leader	3
Analyst	3
Post Doc Researcher	2
Extension Agent	2

Respondents were then asked to describe their current job title. Similar job titles were categorized and can be seen in Table 10. The most common job titles were student (n = 19), technician/scientist (n = 14) and teacher/instructor/professor (n = 10).

Summary

The researchers acknowledge there are limitations to the research, including a lack of a control group. As a result, the changes identified in the results may be due to external circumstances and not just participation in the internship experience. However, questions were framed to try to extract changes respondents felt were attributable to their internship experience. The results of this study suggested that hands-on research experiences at the undergraduate level improved the respondents' self-reported research-related skillset. These findings support the notion that learning environments offering direct contact with and applicability of, research concepts will encourage deeper learning and transfer of skills (Beard and Wilson, 2006; Lamm et al., 2011).

In addition, while career choices cannot be directly associated with participation, a majority of the research internship participants chose to work in science-related field after graduation. They also were likely to have jobs with universities or government and 68% went on to graduate school and/or pre-professional school.

Since these findings could indicate that the hands-on research experiences helped foster efficacy in the development of research-related skills, STEM faculty may find it useful to encourage their students to engage in these research activities. Furthermore, the research experience encouraged students to engage in courses they would not have otherwise considered, leading to further development of STEM related knowledge and potential application of that knowledge in their future careers. These findings also support Kolb's theory of experiential learning, in that students learned about research in a hands-on way in which they were asked to directly apply their learnings in the fields, labs and other settings in which they were engaged. An important piece of experiential learning theory is the impact of hands-on learning and positive personal experience on future engagement in that activity (Baker et al., 2012; Kolb 1984; Roberts, 2006). Their self-reported change in research skills and their high engagement in graduate school and specialized careers could indicate they were able to use what they learned during their internship again in future situations.

To further understand the impact of research internships on future career trajectory, a study should be conducted that uses a control group of students that were similar to research intern participants but not engaged in an internship, so that findings related to research skill growth and future career choices could be compared. Additionally, further studies could explore the relationship between research internship experiences and the psychological impact on students' confidence and feelings of efficacy towards becoming part of the future scientific community. Past research has indicated undergraduate research experiences and in particular, relationships with faculty, can inspire students to become part of the scientific community (Hunter et al., 2007). In addition to research skills, students could be asked to describe their socio-emotional experiences and whether those experiences reaffirmed or changed their perceptions of themselves and their potential for STEM-focused careers and/or graduate studies.

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