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NACTA Journal

the professional journal
advancing the scholarship of
teaching and learning in
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Stakeholders' Perspectives: Students' Perceptions of Retention Efforts in a College of Agriculture



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Abstract

Researchers' examined a college of agriculture's retention efforts from the students' perspective. More specifically researchers' sought to determine what impact, if any, freshman seminar courses had on the first-year student experience. Additionally, researchers examined student interactions with faculty in the college, the quality of educational experience and questioned whether participation in extracurricular activities contributed to student social integration. Lastly, the researchers determined whether student classification influenced satisfaction with the educational experience within the college. Results indicated students viewed retention efforts favorably; however, a sense of academic "community" was lacking and highly desired.

Introduction

Undergraduate student enrollment in American colleges and universities continues to increase nationally while retention of these students perpetually declines. According to the National Center for Educational Statistics (2007), enrollment in degree-granting institutions increased by 16% between 1985 and 1995; however, between 1995 and 2005, enrollment increased by a rate of 23% from 14.3 million to 17.5 million. It is evident that while overall enrollment numbers have increased, degree completion rates for first-time, first-year freshmen remain low. Snyder, Dillow and Huffman (2007) found that 58% of first-time, first-year freshmen that enrolled in a four-year college between 1995 and 1996 completed a bachelor's degree by 2001. Approximately 7% percent of these students completed a certificate or associate's degree, 14% were still enrolled without receiving a degree, and 21% were no longer working toward a bachelor's degree (Snyder et al., 2007). These statistics highlight a discrepancy between entering college freshmen and administrative retention efforts.

While administrators realize the need for student retention efforts, programming is often designed and implemented without fully understanding student needs. This is often haphazard, as Tinto (1993) states, "*Though there is much to be gained from understanding how similar types of institutions have successfully addressed the issue of retention, it falls upon the individual institution to assess for itself the wisest course of its own action*" (p. 192). In other words academic institutions must assess the needs of the most valued asset; the student, before implementing retention policies.

Role of the Academic Institution

Tinto's (1993) theory focuses on critical periods in the typical college student's career when actions by the institution can be effective in preventing departure. The first critical period occurs during the student's first formal contact with the institution. The application process, specifically, is when a student first forms an impression of the social and intellectual character of the institution. If the institutions materials present unclear or unrealistic expectations, it is easy for the student to misinterpret the realities of their first year, possibly leading to disappointments and departure.

Tinto (1993) also identifies orientation programs as another source of early departure. These programs are the beginnings of integration into the institution. Most new students desire accurate and complete information about institutional life, degree requirements and where to find assistance. However, most institutions fail to provide this information or fail to provide it in a manner understood by the student (Tinto, 1993). However, if used properly, orientation programs can be quite effective in assisting with the transition to college.

Tinto (1993) lists transition assistance programs, counseling, advising, early contact programs and integrated first-year programs as effective tools

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institutions can use to positively contribute to retaining students. This includes integrating ceremonies and rituals to help new students assimilate into the life of a community. If properly conceived, freshman year ceremonies can assist students in overcoming the difficulties associated with separation and transition (Tinto, 1993).

Based on these indicators, Tinto (1993) explains that institutions' long-term intervention programs should focus on continuing forms of academic assistance, advising, counseling and educational programs that seek to involve students into the life of the institution. It is essential for members of the academic community to demonstrate the institution's commitment to the welfare of its students by focusing on educational growth and retention (Tinto, 1993).

College of Agriculture Student Attrition

Within the Commonwealth of Kentucky, the State General Assembly enacted the Postsecondary Education Improvement Act of 1997 (House Bill 1) designed to evaluate post-secondary quality and retention. According to this mandate, Kentucky must have a major comprehensive research institution ranked nationally in the top twenty public universities. To be in compliance with this mandate, the president of the university imposed directives regarding student enrollment, retention rates and graduation rates which were outlined in the university's 2020 Business Plan (2005). According to the plan, enrollment at the university must be increased by 7,000 students, retention rates for first-time, first-year students must increase to 92% and the six-year graduation rate must increase to 77.5% to become a top 20 institution by 2020. College enrollment and retention rates reported at the time of this study are presented in Table 1.

In response to the low graduation and retention rates at the University of Kentucky, the 2007-2008 \$2 billion budget mandated more than \$35 million to be targeted toward efforts to improve retention and graduation rates. Specific initiatives included hiring additional faculty and academic advisors, an increase in student financial aid to offset tuition increases, classroom and laboratory renovations and an increase in faculty and staff salaries (Blanton, 2007).

Furthermore, university administrators initiated several retention efforts. One such effort was the implementation of the Academic Alert system. This system identifies students who may be experiencing or have the potential to experience academic difficulty such as students with low exam scores or poor attendance. Representatives

from each college receive information on these students so that they can contact them and provide assistance. In an effort to emphasize proactive student development, the university restructured recruitment programs and the admission process to be more academically focused. In doing so, prospective students had a more realistic expectation regarding the academic demands required by the university. Additionally, the university released its University Island in Second Life to assist with integration into the institution through information, resources and improved social networking.

The university also increased its offerings of the freshman seminar course AG 101: Academic Orientation so that the majority of first-year students could enroll in this course. AG 101 is taught by faculty and staff from across campus and is designed to give freshman students an orientation to college. Students receive instruction on topics such as academic expectations, utilizing campus resources, diversity, alcohol education, managing stress, classroom decorum, academic advising and managing credit card debt.

While these efforts represent campus wide initiatives to improve retention, the College of Agriculture made additional efforts to improve retention. These efforts include creating a full-time advising position that focuses on success and retention of the college's first-year students. Another included a redesign of the required GEN 100: Issues in Agriculture course. The course became restricted to freshmen and the curriculum includes a required summer reading, a service learning project and an orientation to campus. In addition to these efforts, workshops for freshmen on academic probation, focusing on time management skills, study skills and test taking strategies, were implemented to reduce student departure.

While these initiatives support established literature, they were designed and implemented without student input. The purpose of this study was to examine the influence of college retention efforts from the students'

Table 1: University College Retention Rates

College	Fall 2007 Enrollment Retained	Retained Within college	Retained Within University	Total Retention Rate
Agriculture	258	74.8%	7%	81.8%
Arts & Sciences	767	70.9%	13.7%	84.6%
Business & Econ.	385	70.4%	11.4%	81.8%
Comm. & Info. Studies	154	61.7%	9.7%	71.4%
Design	63	81.0%	11.1%	92.1%
Education	199	72.9%	11%	83.9%
Engineering	380	60.8%	23.1%	83.9%
Fine Arts	133	63.2%	15.7%	78.9%
Health Sciences	124	57.3%	17.7%	78.0%
Nursing	168	70.8%	7.2%	78.0%
Social Work	15	80.0%	N/A	80.0%
University Studies	1189	55%	23.6%	78.6%

Adapted from the University Institutional Research, Planning, and Effectiveness website.

Stakeholders' Perspectives:

perspective. The specific areas explored included: student first year experience, interaction with faculty, social integration, mattering and satisfaction. These areas were chosen based on prior research pertaining to student development and retention (Kuh, 2007; Pascarella and Terenzini, 2005; Spady, 1970; Tinto, 1993).

The researchers sought to determine what impact, if any, freshman seminar courses have on the first-year student experience. Additionally, they examined student interactions with faculty in the college, the quality of educational experience and questioned whether participation in extracurricular activities does contribute to student social integration. Lastly, the researchers determined whether student classification influenced satisfaction with the educational experience within the college.

Methods

The primary mode of inquiry included a researcher-developed survey. Surveying was chosen due to its versatility, low cost and its ability to generalize findings from a small sample size to the larger population (McMillan and Schumacher, 2001). The electronic survey was developed and posted using www.surveymonkey.com for participants to complete. This website was chosen for its ease of operation by the user, its data analysis tools and because the sample possesses a high level of computer literacy (Poynton, 2004).

The survey consisted of closed-form, open ended and opinion questions based on the primary themes of Tinto's theory of student departure and those of supporting theorists. Closed form questions were designed to provide student demographic data. Participants were asked to indicate the extent to which he/she agrees or disagrees for each statement within the opinion-based section. Respondents were only to indicate N/A for questions that truly did not apply to him/her. Response categories were abbreviated using the following acronyms: SA-strongly agree; A-agree; D-disagree; SD-strongly disagree; N/A-not applicable; AVG-rating average; N-total response count. The rating average was computed using the rating scale: 4-strongly agree; 3-agree; 2-disagree; 1-strongly disagree; 0-not applicable (Johnson and Christensen, 2000).

The target population included undergraduate degree seeking students enrolled in the College of Agriculture. Students were selected from the years 2005-2008 as they represented the time period of program implementation. Non-degree seeking students were excluded because most non-degree seeking students complete prerequisites to gain entry into a professional program (i.e. pharmacy, medicine, veterinary science) and do not intend to complete a degree at the university.

Once non-degree seeking students were removed, the population included 1,216 students. For a population of 1,000, a sample size of 278 respondents would be needed to obtain a confidence level of 95%, (Salant and Dillman, 1994). Using this information as a guide, the sample size was comprised of 278 students who were randomly selected from the target population. To secure a random sample a spreadsheet was provided by the Director of the Advising Resource Center for the College of Agriculture. Data were then sorted by student identification number. From the target population, 94 students participated in the study resulting in a response rate of 34%. Research has shown a continued decrease in response rates and that techniques which have traditionally been applied to mail surveys to increase response rate do not affect the response rate to email surveys (Sheehan, 2001). However, the sample represents the wide range of characteristics embodied by the broader student population. Therefore, the results of this study can be accurately generalized to the total student population in the College of Agriculture.

The study was reviewed and approved by the University of Kentucky Internal Review Board prior to implementation. It was then pilot tested to establish content validity and to substantiate questions, format and evaluative scales (Creswell, 2003). The pilot test included 37 students enrolled in an undergraduate course within the College of Agriculture. Suggested revisions included formatting adjustments and the addition of college expectation questions. After revisions were made, the survey was sent to several college faculty for review.

Following faculty approval, the survey was posted online for 41 days, allowing sufficient response time (Schaefer and Dillman, 1998).

Participants completed a survey during the Spring Semester of 2009. To solicit participation in this study, an e-mail with the study's description, objectives, purpose and instructions for the survey was sent to the sample population requesting participation. A total of five follow-up e-mails were sent to the sample to solicit full participation (Schaefer and Dillman, 1998). All respondents, identified by their student identification number, were entered into a drawing to receive one of ten \$25.00 gift cards. Recipients of the gift cards were randomly selected with the assistance of a random number generator.

Once data were collected, chi-square tests were used with varying independent and dependent variables to measure certain findings for significance (Johnson and Christensen, 2000). For analysis purposes, responses to the rating scale opinion questions were combined into single categories so that the data could be simplified

and more organized for analysis. Strongly agree and agree responses were combined into the single category of “agree” and responses of strongly disagree and disagree were combined into the single category of “disagree.” In addition, responses to the four open ended questions were categorized and coded so that parallel themes could be established. The data collected from respondents were used to identify characteristics that could be generalized to the total student population within the College of Agriculture.

**Table 2: Student Retention Survey Responses:
Opinion Questions related to First-Year Student Experience**

Question	SA	A	D	SD	N/A	AVG	N
I completed AG 101 and found it to be a useful course.	1.1% (1)	21.6% (19)	5.7% (5)	2.3% (2)	69.3% (61)	2.70	88
The information I learned in AG 101 helped me adjust to college.	1.1% (1)	20.7% (18)	6.9% (6)	2.3% (2)	69.0% (60)	2.67	87
For students who began as freshmen in fall 2008 ONLY: Completing GEN 100 as a freshman in fall 2008 made me feel more connected to the College of Agriculture.	9.2% (8)	14.9% (13)	4.6% (4)	2.3% (2)	69.0% (60)	3.0	87
I feel that my high school experience adequately prepared me for the expectations of college.	17.0% (15)	39.8% (35)	21.6% (19)	19.3% (17)	2.3% (2)	2.56	88

Limitations of the Study

The primary limitation of the study was that the results are contextual, pertaining only to undergraduate degree seeking students in the College of Agriculture. However, this was intentional as the study aligns with Tinto (1993) in that institutions must evaluate their own needs in order to properly implement retention policies.

Another limitation was the period of time in which the study was conducted. Due to the length of time required to develop the survey, conduct the pilot test, revise the survey and undergo the institutional review board’s approval process, the study was not made available for participation until three weeks prior to the end of the academic semester. During this time, students are typically overwhelmed with academic demands and are reluctant to devote their energy to additional activities, which may have affected the response rate.

Finally, researcher bias could be inferred as the researchers were employed by the College of Agriculture and have associations with many members of the sample. In an attempt to diminish this bias, survey research was conducted so that members of the sample would be free to express honest and sincere confidential opinions without any influence from the researcher.

Results and Discussion

First Year Student Experience

Approximately 74% of students who completed AG 101, the university freshman seminar course, found it to be a useful course (Table 2). Additionally, 70% of these students found that the information learned in AG 101 helped them adjust to college. The redesigned GEN 100: Issues in Agriculture course also proved to be beneficial to these students. For freshmen who completed the course in fall 2008, the first term in which the course was offered only to first-year College of Agriculture students, 74% of respondents agreed that the course helped them feel more connected to the college.

Additionally, results indicated that only 58% of the respondents felt their high school work adequately prepared them for college. This finding suggests that a large percentage of students (42%) do not feel adequately prepared for college-level work by their high school.

Interactions with Faculty

Approximately 69% of respondents had regular interactions with faculty outside of the classroom and those interactions were positive (Table 3). Students with majors in Career and Technical Education (100%), Food Science (100%), Forestry (100%), Community Communications and Leadership Development (85%) and Equine Science and Management (80%) had the highest percentages of regular interactions with instructors outside of the classroom. The results suggest that students were developing close, professional relationships with faculty. Of the respondents, 81% agreed that they had developed a close, professional relationship with at least one faculty member. Furthermore, the numbers of clubs, organizations and/or intramural sports respondents are involved in significantly impacted their interactions with faculty (Table 4). This could imply that students involved in extracurricular activities have more opportunity for interactions with faculty.

Data from the opinion based questions suggested relations between faculty and students in the College of Agriculture are generally positive. However, there also seemed a desire for improved relationships and clearer communication. One of the common themes in the open-ended responses related to the development of relationships and student mattering. This can be best articulated in the following student quote:

“How about if [administrator] and his office assistants eat in the deli and have conversations with students for one...I’ve had wonderful interactions with them, and if they could spend time with the students outside of the office setting it would be incredibly beneficial—students would see them in a different light.”

Stakeholders' Perspectives:

Social Integration

Approximately 95% of respondents developed close, personal relationships with other students since enrolling in the university (Table 5). Involvement in clubs, organizations and/or intramural sports significantly influenced these relationships (Table 6). This finding suggests that involvement in extracurricular activities contributes to the development of relationships with other students. Additionally, 91% of respondents indicated that participation in extracurricular activities positively contributed to their college experience.

The results of the opinion questions suggest that most students socially integrated into the college and were involved in extracurricular activities. However, a common theme found in responses to the open-ended questions included a desire for more opportunities for faculty/student involvement, enhancing the academic community within the college:

I feel that more programs designed to stimulate interactions between students on the lines of a social with benefits like food and music. This would create bonds and help students that may not know each other to meet, interact and possibly study together improving scores and friendships. Success in class would lead to a greater pride in the programs after we leave and that leads to suggestions to prospective students from alum.

Based on these responses, it was clear that students desired more opportunities for both students and faculty to become more involved in the college. Students wanted more events such as picnics and cookouts that create a fun, social community for both students and faculty.

Mattering

Approximately 64% of respondents felt that their success mattered to the administration of the university (Table 7). In comparison, 92% of respondents felt that their success mattered to College of Agriculture faculty. This suggests students believed they mattered more to college faculty than to university administration. Furthermore, 97% of respondents felt that most faculty members in the college were genuinely interested in teaching and student learning. Likewise, 84% of respondents felt that their advisor positively contributed to their educational experience. Respondents' major did not significantly impact response. However, students with majors in Agricultural Biotechnology (71%),

Table 3: Student Retention Survey Responses to Interactions with Faculty

Question	SA	A	D	SD	N/A	AVG	N
I have regular interactions with instructors outside of the classroom.	19.5% (17)	48.3% (42)	23.0% (20)	6.9% (6)	2.3% (2)	2.82	87
The interactions I have with instructors outside of the classroom are positive.	34.1% (30)	53.4% (47)	2.3% (2)	1.1% (1)	9.1% (8)	3.33	88
Since enrolling in the university, I have developed a close, professional relationship with at least one faculty member.	39.8% (35)	40.9% (36)	14.8% (13)	4.5% (4)	0.0% (0)	3.16	88

Table 4: Opinion Question of Involvement in Extracurricular Activities

How many university or college clubs/organizations/intramurals are you an active member in?							
		0	1	2	3	4	N
The interactions I have with instructors outside of the classroom are positive.	Agree	18	14	22	12	3	69 86.25%
	Disagree	0	1	1	0	1	3 3.75%
	N/A	6	2	0	0	0	8 10.00%
	N	24	17	23	12	4	80 100.00%

Chi Square =16.6872 df=8 p=0.0335

Table 5: Student Retention Survey Responses Related to Social Integration of Students

Question	SA	A	D	SD	N/A	AVG	N
Since coming to the university I have developed close personal relationships with other students.	48.9% (43)	46.6% (41)	2.3% (2)	2.3% (2)	0.0% (0)	3.42	88
My participation in student clubs, organizations, and/or intramural sports positively contributes to my overall college experience.	29.5% (26)	39.8% (35)	6.8% (6)	0.0% (0)	23.9% (21)	3.30	88

Table 6: Student Involvement in Extracurricular Activities

How many university or college clubs/organizations/intramural sports are you an active member in?							
		0	1	2	3	4	N
Since coming to the university, I have developed close, personal relationships with other students.	Agree	20	17	23	12	4	76 95%
	Disagree	4	0	0	0	0	4 5%
	N	24	17	23	12	4	80 100%

Chi-square=9.8246 df=4 p=0.0435

Landscape Architecture (67%), and Animal Sciences (60%) felt that their advisors contributed the least to their overall educational experience.

Satisfaction

The final critical period as identified by Tinto (1993) lies in the years beyond the first when students decide either to leave higher education altogether or to transfer to another institution. Related to this decision is student satisfaction with their educational experience. The results of this study suggest that satisfaction was generally high for students in the College of Agriculture.

Based on the findings for opinion questions related to satisfaction (Table 8), 85% of respondents were satisfied with the education they were receiving at the university and 89% felt that their degree program was properly preparing them for a career after graduation. Neither students' major nor classification significantly influenced the results. However, students majoring in Animal Sciences had the lowest level of educational satisfaction at 60%. Additionally, students majoring in Animal Sciences and Landscape Architecture had the lowest positive response regarding career preparation with 73% and 67%, respectively.

Conclusions/Recommendations

First Year Experience

The first year of college is a critical transition period in which student withdrawal is the highest (Tinto, 1993). Within this study the college is assisting with the transition from high school to college by offering students freshman seminar courses. This is supported by literature that indicates providing students with freshman seminar courses has been shown to be an effective retention strategy and aid in the transition (Tinto, 1993; Kuh, 2007). The results of this study confirmed that students found value in the freshman seminar courses and that they positively contributed to the students' educational experience.

Students found the freshman seminar courses to be beneficial as they provided useful information and help them adjust to college. Therefore, these courses should be expanded to help students feel connected with the university and college. First-year seminar courses could also be used to help familiarize students with the social and academic demands of college as well as university policies and procedures. This may help reduce some of the anxiety associated with the first-year student experience and assist students in being better prepared for college life.

Interactions with Faculty

Students indicated they had positive interactions with faculty and were developing professional relationships. This finding coincides with numerous studies that have determined the extent and conduct of interactions with faculty members and students largely determine the impact of collegiate success (Bean, 1980; Pascarella and Terenzini, 2005; Spady, 1970; Thomas, 2000;

Tinto, 1993). One student illustrated this sentiment by stating, "I think overall the relationships are something to take pride in."

Students enjoyed their interactions with college faculty but desired more. The college should consider more opportunities for students and faculty to interact. Students also desire faculty to become more involved in college events currently in place. Students felt college faculty were genuinely interested in their success; however, needed to exhibit that interest by becoming more involved with students. Students participating in this study suggested events such as pep rallies, cookouts, picnics, or club fairs to allow more opportunity for interaction between faculty and students. These functions would assist in creating the feeling of community.

Academic advising has been identified in the literature and in this study as an area that can assist with student retention (Tinto, 1993). Students value their academic advising experience. In order to improve the student advising experience faculty and staff should take advantage of opportunities made available to improve interaction and communication with students.

Social Integration

Results indicated students were developing close, personal relationships with other students, proven to be effective in reducing student departure (Pascarella and Terenzini, 2005; Tinto, 1993). According to Tinto (1993), social integration into the academic institution has a direct correlation with student persistence. Students agreed that involvement in extracurricular activities positively contributed to developing relationships with other students and enhanced their college experience.

**Table 7: Student Retention Survey Questions
Relating to How Relevant Students Feel They Are to the College of Agriculture**

Question	SA	A	D	SD	N/A	AVG	N
I feel that my success as a student matters to the administration of the University.	15.1% (13)	47.7% (41)	22.1% (19)	14.0% (12)	1.2% (1)	2.65	86
I feel that my success as a student matters to the faculty of the College of Agriculture.	31.8% (28)	60.2% (53)	5.7% (5)	2.3% (2)	0.0% (0)	3.22	88
Most faculty members in the College of Agriculture, with whom I have contact, are genuinely interested in teaching.	37.5% (33)	56.8% (50)	3.4% (3)	0.0% (0)	2.3% (2)	3.35	88
My advisor positively contributes to my educational experience.	35.2% (31)	47.7% (42)	10.2% (9)	5.7% (5)	1.1% (1)	3.14	88

Table 8: Student Retention Survey Results Related to Satisfaction

Question	SA	A	D	SD	N/A	AVG	N
11. I am satisfied with the education that I am receiving at the University.	25.0% (22)	60.2% (53)	12.5% (11)	2.3% (2)	0.0% (0)	3.08	88
14. I feel that my degree program is preparing me well for a career after I graduate.	34.1% (30)	52.3% (46)	8.0% (7)	2.3% (2)	3.4% (3)	3.22	88

Stakeholders' Perspectives:

While students were developing relationships with other students, they desired more opportunities for participation in extracurricular activities. Based on this finding, the college should consider implementing activities that are student focused and allow for more interaction between students of different majors. Student suggestions included activities such as picnics, cookouts, volleyball games, student club fairs, pep rallies and concerts.

Mattering

Mattering is derived from studies on people in transition and relates to the collegiate educational experience (Rayle and Chung, 2007; Schlossberg, 1989; Schlossberg et al., 1995). This study revealed students felt that they matter more to college faculty than to university administrators. One student exemplified this aspect by stating, "The faculty generally care and take an interest in their student's success." This suggests that college employees need to understand the importance of their role toward student success. Administrators, faculty and support staff should be aware of the university's mission of student success and understand their role in it. In doing so, students will feel as if they matter not only to the college but also to the entire university. Recommendations for how this can be achieved should be explored further.

Satisfaction

Student satisfaction relates to the years beyond the first when students will decide whether or not to leave higher education (Tinto, 1993). Students felt that their educational experience within the College of Agriculture was welcoming and friendly and were generally satisfied, which positively contributes to their persistence. One student stated his/her satisfaction with this statement, "I think the College of Agriculture is doing a great job!" This was also highlighted in students believing they were adequately prepared for their future careers. Based on this finding, the college needs to continue to provide a positive and supportive environment that strengthens the educational experience.

Implications

This study examined initiatives designed by administrators within the College of Agriculture to improve student retention from the students' perspective. Several of the identified initiatives align with the fundamentals found in the literature on student retention. However, a longitudinal study needs to be conducted using study participants. A longitudinal study could more accurately assess whether or not participants were truly retained. This would allow for a more accurate

analysis of the characteristics prevalent in students who matriculate within the given context. This would also further support the need for students to have a genuine input into retention efforts.

The examined university is a land-grant institution; therefore, a meta-analysis of similar studies should be conducted from similar institutions. In doing so, administrators can identify common retention efforts which should be considered for implementation. Additionally, a meta-analysis of retention studies within colleges of agriculture could potentially reveal characteristics of students that are unique to agricultural majors.

The college should consider conducting a study of students who have not been retained. A study such as this could identify factors that contribute to student attrition. This could assist in isolating specific areas that the college needs to focus on to reduce student departure.

Student retention is one of the most challenging issues facing the higher education community. For an institution to implement effective initiative, research must be conducted so that strategies can be developed that are specific to the needs of the institution and the student. Literature can only provide a framework. The needs of the student at the individual institution must be evaluated so that retention efforts fulfill the needs of the most important component of student retention: the student.

Additional efforts identified by this study need to be considered by college faculty and administrators so the educational experience can be improved for students, which will in turn reduce student departure.

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Student Organization Sponsored Dog Training Classes Provide Experiential Learning Opportunity for Students and Community Participants

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Abstract

The goal of this project was to determine the effectiveness of dog training classes provided by a student organization offered to members of the community at large. An eight-week Canine Good Citizen (CGC) class for dogs taking a CGC test upon completion of the class was offered. Using exit surveys, community participants and students ranked a series of items on a 1 (strongly disagree) to 5 (strongly agree) Likert-type scale. Students ($n = 9$) indicated completion of the course provided a better understanding of dog training (mean = 4.7). Students exhibited an improvement in career skills such as communication and organization. Students showed assisting with the course allowed them to apply class content (mean = 4.0) and a desire for more hands on opportunities (mean = 4.6). The community dog handlers ($n = 29$) indicated that they felt the class improved their dog's behavior (mean = 4.7), the university was providing a valuable service by offering the class (mean = 4.6) and that they enjoyed interacting with the students (mean = 4.2). Providing community dog training classes improved student learning and improved community awareness and support of the university's companion animal program.

Key words: dog, training, experiential learning

Introduction

It is estimated that 62% of the U.S. population owns a companion animal (APPA, 2011). With pet owners increasing demand for higher quality care and products and services for their companion animals, there has been

an increase in demand for highly trained and educated personnel to work in these fields. Undergraduate programs have begun to offer companion animal course work and degree options to meet these needs. However, often these programs have limited or no hands on experiences working directly with companion animals and their owners.

Approximately one-third of freshman in Animal Science at the University of Nebraska – Lincoln indicated an interest in working with companion animals as a career. Their career interests were varied and were in areas such as veterinary medicine, behavior, the pet product industry and animal sheltering. However, many undergraduate students have had limited understanding of dog training principles beyond working with their household pets. Behavior problems are a key concern for companion animal professionals as they are among the leading causes of dogs being relinquished to shelters (Patronek et al., 1996). However, only 24% of dog owners attend a dog training class (Coren, 1999). By partnering with a professional dog trainer, undergraduate students may be able to have a better understanding of the importance of dog training and the proper methods of training to be employed.

This project was a pilot program to determine the impacts on undergraduate students with a companion animal interest on their understanding of dog behavior and their overall college experience. Due to scheduling of the dog training class, it was decided to pilot it as an opportunity for experiential learning through the student organization rather than a class. The impacts on students

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who assisted with the training class as well as the community members who enrolled in the dog training course were evaluated.

Materials And Methods

Training Classes Offered

Students for Education in Exotic and Companion Animals (SEECA) is a recognized student organization on the University of Nebraska – Lincoln (UNL) campus. Student members of the organization share a common interest in companion animals such as dogs, cats, small mammals and exotic animals such as zoo animals. The majority of members are in majors in the College of Agricultural Sciences and Natural Resources such as Animal Science, Veterinary Medicine and Biomedical Sciences and Fisheries and Wildlife.

Student members contracted Prairie Skies, Inc. to provide a dog training class to members of the University population and general public. Prairie Skies, Inc. is a dog training business that provided the dog trainer who led the dog training course and provided the standard course methodology. Students provided pre-class preparation (including advertising, registering class members, facility set up and communicating with attendees) and assisted the trainer in working with handlers during the class. The dog training classes were held on UNL's East Campus in the Animal Science Complex Commons Area or a laboratory practicum classroom. Training classes were offered over four semesters from fall 2009 to spring 2011. During three of the semesters, an eight-week course was offered that targeted those who wanted to complete their Canine Good Citizen (CGC) exam. During the spring 2010 semester, two four-week courses were offered back to back. Those handler and dog pairs who completed both classes were eligible to take the CGC exam, but owners were not required to take both four-week sessions. The course offered was similar to ones offered through other dog training facilities as well as at some shelters or humane societies.

The CGC exam is a standardized test offered through the American Kennel Club (AKC) to evaluate the ability of a dog to apply its training and coexist with people successfully. Dogs and handlers are asked to complete ten exercises to pass the exam. These include accepting a friendly stranger, loose leash walking, coming when called, supervised separation for handler and reaction to another dog (AKC, 2011). The CGC is an initial step in training that seeks to help ensure the dog has good practical training for around the home and community (AKC, 2011). The CGC certification is often required for dogs and handlers who are interested in animal assisted activities such as visiting nursing homes or hospital patients. An independent AKC certified CGC

tester administered the exam to any class participants who wanted to take the exam on an evening following the course completion.

Prior to each course session, university students were responsible for developing class advertising, talking to potential class participants and completing necessary registration paperwork. Dog handlers who participated in the training classes were contacted through advertisements placed on campus or sent out through Prairie Skies e-mail contact list. Handlers who were affiliated (faculty, staff, or student) with the university were given a discount on the training class fee.

Once the courses started, students assisted with check in of class participants, observed the training class and assisted with the class as needed. Often students assisted with practice of parts of the CGC exam that required additional human handlers such as walking through a crowd or accepting a friendly stranger. Students observed the training courses and were able to ask questions of the trainer after each session of the class.

Survey Design

Two surveys were developed for this project. One was developed for undergraduate student members of SEECA who were assisting with the class. The other was developed for members of the public who enrolled in the dog training course with their dogs. Both surveys asked for initial demographic information. This included age, year in school and semester participated in for the college students and dog breed, age of dog and training class participated in for the community members.

Participants were then asked to respond to a variety of questions on a five point Likert-type scale (5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree). Survey questions were categorized to ascertain the effects on student learning and career development as well as understanding of dog training principles for undergraduate students and perception of the university and dog training skills/dog behavior for the community members. Students and community members were provided the survey as a paper copy the last day of class or via e-mail after the class had ended. The survey procedures were approved by the University of Nebraska - Lincoln's Institutional Review Board (IRB).

Statistical Analysis

Data was analyzed using the mixed models procedure of SAS (Cary, NC). For the survey of student participants, the variable of class (upperclassmen vs. underclassman) was analyzed. No differences were noted in student survey responses regardless of class level so data for

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all students were combined. For the data on community participants, the variables of class session participated in and gender of participants were analyzed. In addition, a correlation analysis was run on the responses to the survey questions asked. No differences were noted between class sessions so all data was combined.

Results And Discussion

Students were asked to complete the survey after the first time they assisted with the dog training course. Nine of the 14 (64%) students returned surveys after participation in the dog training course. The student organization that assisted with the dog training course averages thirty members each academic year. Of these nine students, all assisted with the dog training course in more than one semester. Reasons for not assisting with the dog training course were most frequently conflicts with other courses or work.

Students strongly indicated that assisting with the dog training classes helped them learn skills they could apply to their own dog ownership (mean = 4.9, SD = 0.33) and improved their understanding of dog training (mean = 4.7, SD = 1.00) (Table 1). If students participate in dog training classes when they obtain a dog in the future, it could result in more responsible dog ownership. Students were interested in taking a similar dog training course with their own dog in the future (mean = 4.6, SD = 0.73). However, only two students actually completed the course with their dogs. Students had a better appreciation of the human – animal bond (mean = 4.4, SD = 0.73).

Assisting with the dog training class added value to the students' education and professional development (Table 1). Students would like more hands-on experiences similar to this one in college (mean = 4.6, SD = 0.73) and felt it allowed them an opportunity to apply what they were learning in class (mean = 4.0, SD = 0.87). Many club members are Animal Science or Veterinary Medicine and Biomedical Science majors and have taken companion animal courses offered at UNL. The dog training course provided a hands-on opportunity which is not always available with a companion animal science undergraduate program.

Students assisting with the dog training course indicated it allowed them to be better prepared for the future through improving life skills like communication (mean = 4.6, SD = 0.73) and organization (mean = 4.3, SD = 0.71). Students were required to answer owner questions related to the class, dog training and dog ownership in general. Students had to practice problem solving and critical thinking to answer the questions. After

class sessions, they would often talk to the instructor or club advisor and discuss how they could have handled a situation better or seek guidance in answering questions. Students were provided feedback on e-mail communications if they were involved in lining up class materials or information with the community members. They also learned more effective ways to communicate with dog owners such as writing clear e-mail responses to questions or providing detailed answers to questions about training class requirements. Kuh (1995) found that service learning resulted in personal leadership development particularly in the areas of planning, organizing, decision making and managing. Students indicated that they understood the importance of dog training in their future career (mean = 4.4, SD = 0.73), but they did not feel as strongly that helping with the dog training class would help prepare them for a future career (mean = 3.7, SD = 1.00). Because these students may be looking for a career working with companion animals and their owners, having a better appreciation for the importance of dog training may result in them recommending it to more dog owners. Participation in dog training will increase the likelihood of dogs staying in their current home and decrease the risk of injury or relinquishment to a shelter (Duxbury et al., 2003; Bennett and Rohlf, 2007). Students assisting with the course had an opportunity to work with dogs, dog owners and a professional trainer. Based on surveys of freshman animal science majors, over 50% of freshman animal science students at the University of Nebraska-Lincoln are considering attending veterinary medicine. This opportunity can provide experiences that students can utilize in their future careers. Students often have

Table 1. Effects on student understanding of training procedures and undergraduate student learning and career development for students who assisted with a community dog training class. (N = 9)

Item	Mean	SD
I have a better understanding of dog training after assisting with this dog training class.	4.7	1.00
I better appreciate the human-animal bond after helping with this class.	4.4	0.73
I would take a similar dog training class with my dog.	4.6	0.73
I learned skills I can apply to my own dog ownership.	4.9	0.33
I was able to apply what I learned in my university classes to the skills needed for assisting with the dog training class.	4.0	0.87
I would like more hands on experiences like this in college.	4.6	0.73
I can see the importance of dog training in my future career.	4.4	0.73
I feel this experience helped prepare me for a career.	3.7	1.00
I learned the importance of organizational skills when working with people.	4.3	0.71
I learned the importance of effective communication skills.	4.6	0.73
Assisting with this class, made me feel like I was providing an important community service.	4.0	1.12
I found it valuable to interact with members of the public and their dogs.	4.2	1.09
I would assist with a class like this again.	4.4	0.73

Ranked on a scale of 1 – 5: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

limited hands on experience with dog training outside of their own home prior to starting college and entering the work field. In order to improve the impact assisting with the class has on preparing the students for their future career, ways to get the students more involved in the course are being explored. Possible ideas include having the students provide short presentations on dog care or health to the class at the beginning of each session and having the students assist more directly with the dog training rather than just observing. Often after the students observed at the first series of classes, they may have been more likely to assist with future courses and would see a more directly link to career preparation.

In addition to learning life skills, students felt they were providing a valuable community service (mean = 4.0, SD = 1.12). Participation in community service linked with classroom instruction allows students to apply classroom concepts to new situations and be more aware of societal challenges (Markus et al., 1993). Students learning about the challenges of training dogs and working with dog owners may better shape how they react to similar situations in their future careers. Students who volunteer or participate in community service projects during college are more likely to participate in community service as adults (Edwards et al., 2001). By participating in a community based education project, students gain positive perspective of community development and working with community members (Eames-Shevely and Miller, 2008). Because similar dog training classes are offered at local humane societies and shelters, students may be more likely to volunteer in the future. They can apply the skills they learn while working with dogs and dog owners in the dog training class to future experiences.

A total of 29 of the 42 community dog handlers who completed the training class returned the survey resulting in a 69% response rate. The dogs who participated in the class represented 18 different breeds with the most common breeds being Labrador retriever (n = 4), standard poodle (n = 3) and mixed breed (n = 3). The average age of dogs in the classes was 2.5 years old with a range of reported ages of 8 months to 8 years.

No differences were noted in handler survey responses due to gender or session the training class took place. Therefore, means of across all handlers are presented. The community members indicated improvements in their dog's behavior (mean = 4.7, SD = 0.41) and their understanding of dog training (mean = 4.6, SD = 0.55) (Table 2). Participation in training activities is correlated with a decrease in appearance of

Table 2. Effects on dog training and behavior skills and perception of working with University students of dog owners who participated in an on-campus dog training course.

Item	Mean	SD
I would recommend this dog training class to others.	4.8	0.41
The class improved my dog's behavior.	4.7	0.53
The class strengthened the bond between my dog and me.	4.6	0.57
The class taught me important dog training skills.	4.7	0.55
I enjoyed taking this course on campus.	4.4	0.82
I enjoyed interacting with students.	4.2	0.83
I found the students to be helpful.	4.2	0.93
Having college students help with the class made it more worthwhile than another dog training course.	3.8	0.93
I felt I was making a positive impact on the students' college experience.	3.9	0.95
I learned something from working with the students.	3.4	1.09
I felt the University was providing an important public service by hosting this dog training class.	4.6	0.91
This experience improved my views of the University.	3.9	0.79
I would recommend UNL to students interested in studying companion animals based on my experience in this dog training class.	4.1	0.99
Ranked on a scale of 1 – 5: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree		

problem behaviors (Bennett and Rohlf, 2007). Training a dog is a way to improve the bond between owner and animal. Participants in the training class indicated that they felt they had a stronger bond with their dog (mean = 4.6, SD = 0.57) which would decrease the likelihood of the dog being relinquished to a shelter. Training increases the likelihood that dog owners will engage in other shared activities with their dog (Bennett and Rohlf, 2007). On the survey, 18 handlers (62%) indicated they were successful passing the CGC exam, one indicated that they felt they would not be successful so they chose not to take the exam and ten indicated they were not planning to take the exam, but did not provide a reason.

The interaction between the university students and the class participants was critical to the success of the class. Dog handlers enjoyed working with the students (mean = 4.2, SD = 0.83) and found the students to be helpful (mean = 4.2, SD = 0.93). Handlers were relatively neutral on if they learned from the students (mean = 3.4, SD = 1.09), but agreed (mean = 3.9, SD = 0.95) that they felt they were making a positive impact on the students' college experience and having the college students help made the class more worthwhile than other dog training classes (mean = 3.8, SD = 0.93). Student participation varied by session offered depending on student's level of interest. Some students preferred to merely observe the training class, while most assisted the trainer with instruction. Students were given the opportunity to work one-on-one with the dog owners and their dogs during the class. This difference in involvement may have impacted the responses in the dog handler survey related to how they felt they worked with the collect students. Students' confidence in assisting the owners may be increased after participation in more than one

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course, but this information was not collected. Some handlers appeared more interested in interacting with the students than others. This may have resulted in the variation in responses to the survey items. Additional ways to get students involved in future sessions should be assessed to ensure the greatest impact for participants. These could be through previously mentioned methods of having students provide presentations or additional instruction to the students before the class on how they can interact with the dog handlers. In many cases, student volunteers are not used for planning or coordinating community service programs (Edwards et al., 2001). Providing more opportunities for students to be involved in and plan activities might be beneficial in their career development. Students were responsible for the planning of the training classes, but were limited in their ability to provide the instruction. Discussions about having students provide educational sessions at the beginning of future dog training classes have occurred. Students would be able to teach on topics they covered in classes such as vaccinations, nutrition or health care topics.

As an added benefit, the dog training class provided a service to the dog owning members of the community. Participants indicated that they would recommend the training class to others (mean = 4.8, SD = 0.41). Completion of a training class increases the likelihood of a dog remaining in the home (Duxbury et al., 2003). The dog handlers enjoyed taking a course on campus (mean = 4.4, SD = 0.82). Community participants in the class left with a slightly improved view of the university (mean = 3.9, SD = 0.82) and felt the university was providing a valuable public service by offering the class (mean = 4.6, SD = 0.91). Those who completed the survey indicated that they would recommend the companion animal program to potential interested students (mean = 4.1, SD = 0.99) which can be critical to continued recruiting efforts to increase enrollment in undergraduate programs. Providing community service at the university could benefit the program through increased awareness and community support. Service projects allow the university to showcase its students and programs offered while providing community education.

Having students assist with a dog training course can provide a valuable form of experiential learning and community service. Animal Science Departments with companion animal programs or interested students could partner with local shelters or other groups offering training programs to help their students gain more hands on experiences. Many shelters have developed internship programs for student volunteers and assisting with behavior programs can be an added outlet to improve students' understanding of animal behavior and handling. Additionally, finding ways to offer courses on

campus may provide a convenient outlet for students to gain this experience while providing a community outreach program.

Summary and Implications

Offering a dog training course to the community through a university organization such as a student club has many benefits to the students, the community and the university. The demographics in Animal Science programs are changing to include more students interested in companion animals. Most universities have limited opportunities for these students and must look for ways to provide hands on experiences for these students similar to what is provided to students with a livestock interest. Experiences like this allow for improved career development and provide students with a hands-on opportunity to work with dogs and their owners that would not otherwise be provided to them. In addition, the dog training class can serve a role in improved student recruiting as the community becomes more aware of the programs available and may develop stronger ties between the university and community members.

Students benefit by taking advantage of opportunities to become more involved in community service programs. These programs not only provide hands-on learning experience for students, but they are also great ways for students to develop their public and leadership skills. Development of methods to engage the students more directly in the planning and educational process should be evaluated. Students who participate in service projects will develop skills directly needed in the work force as well as be more likely to become life-long volunteers. Partnership opportunities may be available in other areas to provide additional experiential learning for companion animal interested students in the future.

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Actual Versus Preferred Laboratory Classroom Practices: An Evaluation of the Effectiveness of Laboratory Classroom Teaching at the Post-Secondary Level¹

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Abstract

Students' perceptions of the actual and preferred classroom environment were evaluated using the Science Laboratory Environment Index (SLEI). The SLEI evaluates the classroom environment based on five scales: Student Cohesiveness, Open-Endedness, Integration, Rule Clarity and Material Environment. In addition to evaluating the total classroom environment, the level of integration was evaluated between students in a face-to-face lecture course and students in an online lecture course. A sample of 109 post-secondary students enrolled in Introduction to Entomology Laboratory at the University of Florida responded to the SLEI. Results revealed statistically significant differences between the actual and preferred classroom environment. The results suggest that students enrolled in this laboratory course would like to see an increase in activities that fall within all scales of the SLEI. Additionally, there should be a greater level of integration between information presented in lecture and experiments carried out in the laboratory portion of the course.

Introduction

The actual classroom environment has been studied extensively over several decades; however there has been little research on the preferred classroom environment. Due to this lack of research, there has been great interest in understanding a student's preferred classroom environment. Research has shown that students' perception of the classroom environment can affect how the student perceives the quality of the classroom (Dorman, 2008). The quality of the classroom environment has been suggested to have an effect on

student learning as indicated by the level of student achievement (Byrne et al., 1986; Dorman, 2008). When using student learning and achievement as a basis for measuring classroom environment preference, Fraser et al. (1995) found that students achieve better when there is great congruence between the actual and preferred classroom environment. Attempts to close this gap have resulted in greater student outcomes (Dorman, 2008).

In addition to using student outcome and achievement as a basis of evaluating the preferred classroom environment, student perceptions have also been used to determine preferences in classroom environment. Bryne et al. (1986) measured students' preferred classroom environment through the use of three instruments each administered to 1,675 students in grades 7, 9 and 11. The researchers reported that classroom preference was found to be dependent on the age and gender of the learner. Younger students (ages 5-11) preferred structure and class cohesiveness, while middle age students (ages 11-16) preferred competition and older students (ages 16-18) preferred self-initiated activities but also desired cohesiveness. Male students preferred more competition, whereas female students preferred social harmony (Bryne et al., 1986). Based upon this information, age and gender of the learner have been cited as significant factors when assessing the preferred classroom environment.

Age and gender of the learner have influenced classroom perceptions just as overall classroom morale, as perceived by students, has affected the classroom environment. Students have preferred the classroom morale to be more positive than what they have been

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experiencing (Dorman, 2008). Positivity has been characterized as a social and affective characteristic of the classroom. Social and affective characteristics deal with the behaviors of students and teachers and the feeling of the environment generated from those interactions (Ripple, 1965). These characteristics, or feelings developed through interactions have had just as much influence on learning as instructional characteristics (Doll et al., 2010). Social and affective characteristics have helped promote student engagement and active participation in the learning process (Doll et al., 2010). Thus, students will be more committed to learning when they perceive a more positive environment and feel valued and respected by their teacher (Doll et al., 2010).

Review of Literature

Fraser et al. (1993) developed the Science Laboratory Environment Index (SLEI) based upon Moos (1987) general categories of dimensions for conceptualizing all human environments. Moos identifies three dimensions which impact all social climates—Relationship Dimensions, Personal Growth or Goal Orientation Dimensions and System Maintenance and Change Dimensions.

Relationship Dimensions assess “personal relationships in a setting” (Moos, 1987, p. 8). Items such as involvement, cohesion and support are measured within the Relationship Dimensions. Personal Growth or Goal Orientation Dimensions evaluate the “ways in which an environment encourages or stifles personal growth” (Moos, 1987, p. 8). In general, this dimension measures independence and intellectuality, which in classroom settings, is evaluated by assessing a student’s performance and competitiveness.

The System Maintenance and Change Dimensions measure “*how orderly and organized the setting is, how clear it is in its expectations, how much control it maintains and how responsive it is to change*” (Moos, 1987, p. 9). In classrooms, this dimension measures how aware students are of rules and the consequences associated with not following the rules. When utilizing these dimensions to evaluate a social climate, Moos believed a complete picture of the environment could be obtained.

Fraser et al. (1993) based the development of the SLEI on Moos (1987) dimensions and a comprehensive review of the literature to determine environments that are unique to the science laboratory classroom. The researchers also evaluated past classroom environment questionnaires and interviewed numerous science teachers and students in the development of the SLEI. The SLEI was constructed specifically to evaluate the science classroom to examine what makes a science

laboratory classroom unique. Learning in a science laboratory is distinct because laboratory experiments help students meet learning goals through the use of hands on activities.

In order to facilitate hands on activities, adequate science laboratory facilities have been necessary. When adequate facilities have been available, laboratory activities have allowed students to have concrete experiences that were connected with the learning objectives (Freedman, 1997). Facilities have had a great impact on student success in meeting the goals of the teaching and learning of science (Ainley, 1990). Student success in science has been improved through laboratory work that is exciting and encouraging which can positively influence students’ attitude toward science (Freedman, 1997). However, not all students have viewed laboratory work as exciting. Research has shown that students have felt laboratory work is boring and just an act of going through the motions without any clear purpose (Fraser et al., 1993). Therefore, research on students’ perceptions of the science laboratory and their performance within the laboratory is still needed to help improve the teaching and learning of science.

One such study by Freedman (1997) evaluated the effects of hands-on laboratory experience on achievement in science knowledge. Students were assigned to 20 physical science classes. Classes in the treatment group participated in laboratory experiences once a week for 36 weeks, while the control group had no laboratory experience. The effects of the laboratory or non-laboratory setting were evaluated based on mid-term and final examination scores. A significant difference was found between students who participated in laboratory experiences and those that did not, illustrating that students who had laboratory experience achieved higher scores (Freedman, 1997). Research has suggested that science laboratories have been an effective means of teaching students science concepts.

Science laboratories have provided students with the opportunity to have hands on experiences, however students have also needed to understand the concepts being taught in a laboratory setting. McKee et al. (2007) sought to evaluate students’ understanding of the concepts being taught in the science laboratory. Researchers evaluated the conceptual understanding of students in two different laboratory groups: those students that participated in the laboratory exercise and those students who only viewed the lab exercise as a demonstration by the teacher. Results showed no significant difference between the two groups after the experiment, indicating that both hands on learning and demonstration laboratories provided students with the same opportunity to learn. There was no difference

Actual Versus Preferred

in conceptual understanding based upon the students' interaction with the laboratory experience.

In addition to ensuring students develop a conceptual understanding of the information being taught, the information taught in the laboratory should be integrated with the concepts that have been taught in the classroom. Integration has occurred through the use of the laboratory setting as a tool for students to confirm the information learned and to gain a visual representation of processes discussed in the lecture course (Hofstein and Lunetta, 1982). Integration of lecture and laboratory material has been cited as one of the most imperative dimensions of instruction because the student learning experience should be integrated with the rest of the course, or instruction can be meaningless for the student (Byrne et al., 1986). When the courses are not integrated, students have perceived concepts or exercises as unrelated to learning outcomes (Bluic et al., 2009).

One challenge of effective integration has been the delivery method of the lecture course. Recently, alternative delivery methods have been developed for course instruction rather than traditional face-to-face instruction, one such alternative being the Internet. The Internet has become a useful vehicle for delivering courses at the post-secondary level (Perez-Prado and Thirunarayanan, 2002). At the post-secondary level, students have the option of taking courses face-to-face or online. Online instruction has provided the opportunity for the facilitation of information with regard to the type of learner and their location (Johnson et al., 2000). Conversely, researchers (Johnson et al., 2000) have found that face-to-face courses are criticized for encouraging passive learning and not meeting the needs of the individual learners. However, face-to-face instruction has continued to evolve in order to meet the needs of learners (Johnson et al., 2000). There have been benefits and criticisms of both online and face-to-face instruction, but researchers (Johnson et al., 2000) suggested that one method of delivery is not better than the other.

In order to evaluate the two different methods of course delivery, a study conducted by Johnson et al. (2000), placed graduate students in two different versions of the same course, taught by the same instructor, with one version of the course being taught face-to-face while the other was online. Results showed that student satisfaction was slightly more positive for students in a traditional face-to-face environment. Students in the face-to-face course provided a slightly more positive rating of the instructor and of the learning environment characteristics than those enrolled in the online section. Although there was a difference in course ratings between the two groups, there was no difference in the quality

of work submitted from each group or the distribution of grades between the two groups. Although the online students were not completely satisfied with the course and the instructor, they performed at a level equivalent to that of the students in the face-to-face section. If level of performance has been a primary concern, results illustrated that either method of delivery will yield the same outcome however, student perceptions may be important to consider when developing a course.

Based on the aforementioned findings, the fundamental problem this study investigated was the congruence between the actual and preferred science classroom laboratory environment in a post-secondary institution. A lack of congruence could result in lower student achievement. In addition, the level of integration between the lecture and laboratory courses was evaluated, as well as the differences in the face-to-face and online lectures.

Methods

Most of the studies involving the use of the SLEI have been used in secondary education settings. Just as in secondary education, laboratory components are still a vital part of student learning at the post-secondary level. When evaluating science laboratories the previous research using the SLEI has shown that greater congruence between actual and preferred classroom environments has resulted in greater students learning. Research has also shown differences in learners opinions based on course delivery. The objectives of this study were to:

1. Determine if science classroom laboratory instruction at the post-secondary level is operated in a manner that meets the needs of learners by evaluating students' actual and preferred classroom environment.
2. Determine whether material presented in the lecture portion of the class is pertinent to the material presented in the laboratory portion.
3. Determine if there is a difference of opinion concerning lecture/laboratory integration level between face-to-face and online versions of the lecture class.

Each objective was tested at a significance level of .05.

The Science Laboratory Environment Inventory (SLEI) (Fraser et al., 1993) was used to evaluate the actual and preferred classroom environment of post-secondary education students in science laboratory classes. The SLEI contains two forms, a personal form and a classroom form. The personal form evaluates students' perceptions of their role within the classroom and the classroom form evaluates the students' perceptions of the class as a whole. Only the personal form was used to evaluate students' opinions of the actual and preferred classroom environment. The preferred form of the SLEI

consists of 35 items with responses on a 5 point scale with the alternatives of 1 = Almost Never, 2 = Seldom, 3 = Sometimes, 4 = Often and 5 = Very Often. The SLEI contains five scales: Student Cohesiveness (SC), the extent to which students are encouraging and supportive of each other; Open-Endedness (OE), the extent to which activities and experiments are open-ended; Integration (I), the extent to which the laboratory activities are integrated with the theories taught in the lecture portion of the course; Rule Clarity (RC), the extent to which the laboratory is guided by formal rules; and Material Environment (ME), the extent to which the materials and equipment are adequate for the course. Each of these scales were evaluated using seven questions (Table 1) (Fraser et al., 1993). The SLEI was adjusted to meet the needs of the study. Wording within the instrument items was edited to read correctly in American English. The University of Florida Institutional Review Board approved the study and all participants provided written informed consent.

Fraser et al. (1993) validated and tested the SLEI in its original form (72 items and eight scales) in six difference countries (Australia, United States, Canada, England, Israel and Nigeria). After the instrument was tested in each of these countries, an item analysis was conducted on each item to identify the questions which would enhance the consistency and discriminant validity of the instrument. Item analysis procedures were applied separately for the actual and preferred versions so as to develop an instrument that could accurately assess the actual and preferred environment. In addition to the ensuring accurate assessment of the actual and preferred forms, the researchers desired to establish cross-national validity, thus, the item analyses were performed separately for each of the six countries. This item analysis led to the deletion of 20 items and one scale from the original 72 items in the SLEI. The resulting 52 items of seven scales formed the starting point for the factor analyses (Fraser et al., 1993).

A series of factor analyses was run on the remaining 52 items, where the actual and preferred version analyses were run separately. This factor analysis resulted in the deletion of two more scales and two items from each of the remaining scales, resulting in a 34-item, five scale instrument—all scales had seven questions except the Open-Endedness scale which had six. Factor loadings were obtained from the total sample of 3,727 students in 198 classes. A factor loading value of 0.30 was utilized. The actual form had a factor loading greater than 0.30 for each of the 34 items. The pattern for the preferred form was similar. Overall, these results indicate the factorial validity of the 34-item, five scale SLEI (Fraser et al., 1993).

Table 1. Item and Item Scale for the Science Laboratory Environment Index (SLEI) administered to Students Enrolled in Introduction to Entomology at the University of Florida in 2010

SLEI Item	SLEI Scale ^z
I get along well with students in this laboratory class.	SC
There is opportunity for me to pursue my own science interests in this laboratory class	OE
What I do in our lecture class is unrelated to my laboratory work.	I
My laboratory class has clear rules to guide my activities.	RC
I find that the laboratory is crowded when I am doing experiments.	ME
I have little chance to get to know other students in this laboratory class.	SC
In this laboratory class, I am required to design my own experiments to solve a given problem.	OE
The laboratory work is unrelated to the topics that I am studying in the lecture class.	I
My laboratory class is rather informal and few rules are imposed on me.	RC
The equipment and materials that I need for laboratory activities are readily available.	ME
Members of this laboratory class help me.	SC
In my laboratory sessions, other students collect different data than I do for the same problem.	OE
My work in the lecture class is integrated with laboratory activities.	I
I am required to follow certain rules in the laboratory.	RC
I am ashamed of the appearance of this laboratory.	ME
I get to know students in this laboratory well.	SC
I am allowed to go beyond the regular laboratory exercise and do some experimenting of my own.	OE
I use theory from my lecture class sessions during laboratory activities.	I
There is a recognized way for me to do things safely in this laboratory.	RC
The laboratory equipment which I use is in poor working order.	ME
I am able to depend on the other students for help during laboratory classes.	SC
In my laboratory sessions, I do different experiments than some of the other students.	OE
The topics covered in lecture are quite different from topics in laboratory sessions.	I
There are few fixed rules for me to follow in laboratory sessions.	RC
I find that the laboratory is hot and stuffy.	ME
It takes me a long time to get to know everybody by his/her first name in this laboratory class.	SC
In my laboratory session, the teacher decides the best way for me to carry out the laboratory experiments.	OE
What I do in laboratory sessions helps me to understand the theory covered in lecture.	I
The teacher outlines safety precautions to me before my laboratory sessions commence.	RC
The laboratory is an attractive place for me to work in.	ME
I work cooperatively in laboratory sessions.	SC
I decide the best way to proceed during laboratory experiments.	OE
My laboratory work and lecture class work are unrelated.	I
My laboratory class is run under clearer rules than my other classes.	RC
My laboratory has enough room for individual or group work.	ME

^z SC= Student Cohesiveness, OE= Open-Endedness, I= Integration, RC= Rule Clarity, and ME= Material Environment

The instrument developers also wanted the SLEI to be capable of differentiating between perceptions of students in different classrooms. Thus, a one-way analysis of variance (ANOVA) was performed for each scale. Results indicated that each scale differentiated significantly between classrooms (Fraser et al., 1993).

After all item analysis procedures and validity was established, the refined version of the SLEI, with 34-items and five scales, was administered to senior high school students. After administering the instrument a decision was made to add an additional item to the

Actual Versus Preferred

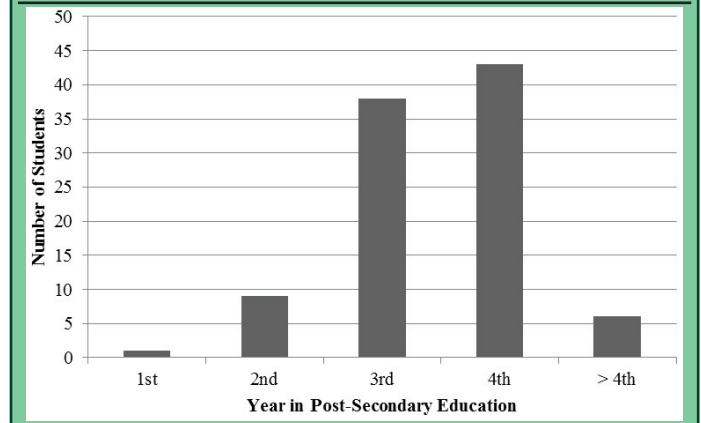
Open-Endedness scale so that each scale would have seven items. This made the instrument easier to score and the 35-item version was cross-validated with 1,594 students (Fraser et al., 1993).

The target population for this study was post-secondary students enrolled in an upper division course of Introduction to Entomology at the University of Florida. The survey was administered three-quarters of the way through the semester so that students were able to evaluate all relevant aspects of their laboratory experience. The total sample that responded to the SLEI consisted of 109 post-secondary education students enrolled in five different sections of the course. Each laboratory section had a different instructor, but all students had the same instructor for the lecture portion of the course, regardless of the method in which it was delivered (i.e., face-to-face or online). Students enrolled in the online version of the lecture course, were required to attend laboratory sessions on campus. Statistics were calculated using SPSS® version 17.0 for Windows™. Post-hoc reliability analysis of the instrument yielded the following Cronbach's alpha coefficients for the five scales, for both actual and preferred scores: SC actual=0.79; SC preferred=0.64; OE actual=0.53; OE preferred=0.59; I actual=0.84; I preferred=0.69; RC actual=0.57; RC preferred=0.53; ME actual=0.66; ME preferred=0.57.

Results

Demographic information was collected for the variables of gender, major, college, year in post-secondary education, if the course was required and if the student was admitted as a freshman or a transfer student from a community college. Out of 109 respondents, 48% (n=52) were male and 52% (n=56) were female. In total, there were 20 different majors reported from all five sections of the course. The most prevalent major reported was biology at 39% (n=42). Of those 20 majors, 10 majors were housed in the College of Agricultural and Life Sciences, two majors (biology and microbiology and cell sciences) are shared with the College of Agricultural and Life Sciences and the College of Liberal Arts and Sciences, the other eight majors were distributed among three other colleges at the University of Florida. In total, 61% (n=60) students are enrolled in the College of Agricultural and Life Sciences. As reported in Figure 1, the majority of students were undergraduate students with 45% (n=43) being seniors, while the next most prevalent were juniors at 39% (n=37), then sophomores at 9% (n=9) and freshman at 1% (n=1). The remaining students (6%; n=6) were post-bachelor, master's or PhD students. This course was required by 65% (n=70) students, while the other 35% of students took this course

Figure 1. Year in Post-Secondary Education of students enrolled in an Introduction to Entomology course at the University of Florida in 2010.



as an elective. The majority of undergraduate students enrolled in this course were admitted to the University of Florida as a freshman, while 34% (n=33) of the students were admitted as a transfer student.

The first objective of this study was to determine if this science classroom was meeting the needs of its learners, through the occurrence of greater congruence between the actual and preferred classroom environment.

To determine if there was a significant difference between the actual and preferred scores of each scale on the SLEI an analysis of variance (ANOVA) was performed (Table 2). Differences between the actual and classroom environment were found to be significant in each of the five scales.

Table 2. Analysis of Variance (ANOVA) of Mean Scores for the Five Scales on the Science Laboratory Environment Index (SLEI) for Students Enrolled in Introduction to Entomology at the University of Florida in 2010 (n=109)

Scale	SS	df	MS	F
Student Cohesiveness	15.29	16	.96	3.64**
Open-Endedness	10.25	24	.44	2.51**
Integration	29.26	16	1.83	4.94**
Rule Clarity	19.92	22	.91	9.13**
Material Environment	7.94	14	.57	4.57**

**P=0.01

Table 3 depicts the mean scores for each of the scales of the SLEI, as well as the minimum, maximum and standard deviation for each scale. In every SLEI scale (e.g., SC, OE, I, RC, and ME), students preferred the items listed in that scale to occur more often.

The second objective in this study was to determine if the information provided in the lecture portion of the class was relevant to the information presented in the laboratory portion of the class. Evaluation of this objective was based on the analyses conducted for the integration scale. The seven questions associated with the integration scale measured the extent to which the laboratory activities are integrated with non-laboratory and theory classes. Based on the analyses conducted there was a statistical significance, with a P-value<.01.

Table 3. Minimum, maximum, mean and standard deviation for all scales of the Science Laboratory Environment Index (SLEI) on Actual and Preferred Scales for Students Enrolled in Introduction to Entomology at the University of Florida in 2010

Scale ^z	Actual ^y				Preferred ^y			
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Student Cohesiveness	2.14	5.00	3.63	0.60	3.00	5.00	4.23	0.50
Open-Endedness	1.29	3.71	2.50	0.48	1.43	4.57	2.87	0.59
Integration	1.14	5.00	3.61	0.77	2.71	5.00	4.19	0.61
Rule Clarity	2.57	4.68	3.69	0.51	2.43	5.00	3.78	0.51
Material Environment	3.29	5.00	4.35	0.43	2.71	5.00	4.66	0.35

^z Scores were based on a 5 point scale, with "1"= Almost Never and "5"=Very Often.
^y Actual indicates how the practices were actually occurring the laboratory and preferred indicates how the student would prefer for those practices to occur in the laboratory.

Table 4. Analysis of Variance (ANOVA) of Mean Scores for the Integration Scale between Face-to-Face and Online Students Enrolled in Introduction to Entomology at the University of Florida in 2010 (n=109)

Scale	SS	df	MS	F	p
Integration ^y -Actual ^z	.23	1	.04	.38	.57
Integration ^y -Preferred ^z	.14	1	.14	.37	.55

^z Actual indicates how the practices were actually occurring the laboratory and preferred indicates how the student would prefer for those practices to occur in the laboratory.

^y Integration is the extent to which the laboratory activities coincide with the information presented in the lecture portion of the course.

The third objective for the study was to determine if there was a difference of opinion in the integration level of the lecture and laboratory portion of the class between the students taking the online lecture class versus the face-to-face lecture class. In total, 55% (n =58) of students were enrolled in the face-to-face version of the lecture class and 45% (n =48) of the students were enrolled in the online version of the lecture class. Table 4 depicts the analysis of variance (ANOVA) performed, which revealed that there was no statistical significance between students in the face-to-face and online versions of the course concerning their perceived level of integration between the lecture and laboratory class.

Figure 2 displays the mean scores for each of the five scales used in the SLEI. The figure depicts scores based on student's enrollment in a face-to-face or online class and their actual and preferred environment.

Discussion

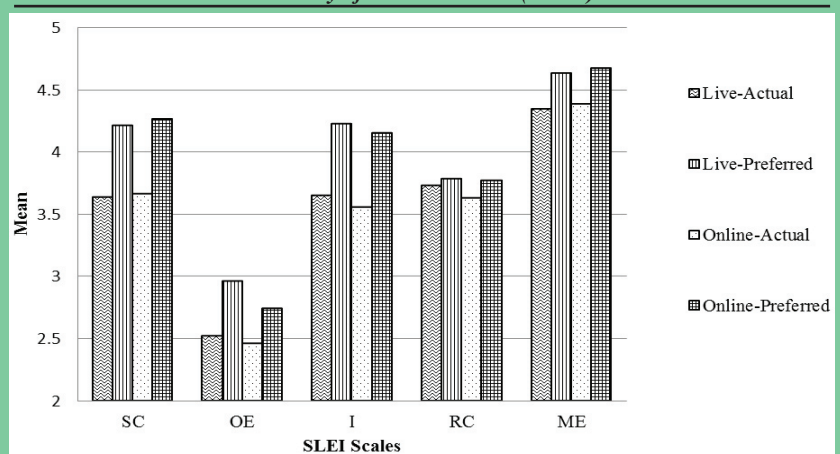
The SLEI indicated that there was little congruence between the actual and preferred classroom environment, thus indicating that students would prefer for there to be more student cohesiveness, greater open-endedness, greater integration, greater rule clarity and better laboratory facilities. Students had a greater score in the preferred column in each of the scales, which could indicate a variety of preferences. These students could prefer more self-initiated

activities and greater cohesiveness as found by Byrne et al. (1986) in a similar study. If greater cohesiveness is desired, students may prefer a more positive classroom environment (positivity is associated with the relationships between student-teacher and student-student), which is a common request of students as found by Dorman (2008).

In addition to the desire for a more cohesive classroom, this study also found that this laboratory classroom was dominated by close-ended activities (e.g., laboratory activities guided by exact procedures, prescribed laboratory experiments with no room for deviation). Fraser et al. (1995) also found this when evaluating the science laboratory classroom. Students in this study would prefer for there to be greater open-endedness than what they are currently experiencing (e.g., the opportunity to pursue students' own interest within the realm of the course, the opportunity to design students' own experiment and procedures). However, this desire for greater open-endedness is dissimilar to the work of McRobbie and Fraser (1993), as those researchers found that the students did not desire more open-ended activities.

Students in this study would prefer better laboratory facilities, which can result in an enriched learning environment, which includes a setting that results in greater involvement in purposeful activity (Ainley, 1990). Purposeful activity promotes greater student learning, which can be accomplished through science laboratory facilities if they are operated in a manner that is exciting and encouraging for students (Freedman, 1997). Exciting

Figure 2. Mean scores for each scale of the Science Laboratory Environment Index(SLEI) administered to students in an Introduction to Entomology course at the University of Florida in 2010 (n=109).



Note: SC= Student Cohesiveness, OE= Open-Endedness, I= Integration, RC= Rule Clarity, and ME= Material Environment

Scores were based on a 5 point scale, with "1"= Almost Never and "5"=Very Often.

Note: Actual indicates how the practices were actually occurring the laboratory and preferred indicates how the student would prefer for those practices to occur in the laboratory; Live is those students who took the lecture course face-to-face and online indicates those students who took the lecture course online.

Actual Versus Preferred

and encouraging environments can promote more positive attitudes toward science (Freedman, 1997).

Fraser et al. (1995) found that greater student achievement occurred when there was greater congruence between the actual and preferred classroom environment, as evaluated by students. Results in this study, indicated that students would prefer for greater congruence between the actual and preferred classroom, in all five scales of the SLEI, therefore, student achievement could have been low, due to the lack of congruence between each scale. If student achievement had been measured using a numerical score, or letter grade, obtaining the grades from each of the five course sections would have been beneficial to use in determining if there was an affect from the reported lack of congruence in actual and preferred classroom environments.

The integration scale was evaluated alone to determine if there was adequate integration between lecture and laboratory portions of the course. The data indicated that there was a significant difference between the actual and preferred level of integration, thus showing that students would prefer for there to be more integration between the laboratory class and the lecture or theory portion of the class. Integration may be the most important aspect of the laboratory environment that was evaluated with respect to student learning. Research (Bliuc et al., 2009) has shown that integration of knowledge is imperative to student learning. If information is not integrated, students can perceive material as unrelated and not important to the overall learning goal (Bliuc et al., 2009).

When evaluating the integration of a face-to-face or online lecture with the laboratory classroom, it was predicted that students in the face-to-face lecture course would perceive greater integration of the material than that of the online lecture students. However, both categories of students felt the same way about the integration of the material into the laboratory portion of the course. There was no significant difference between their attitudes concerning integration. As seen earlier, students did not feel the level of integration was adequate, however, there was no difference between those students in the face-to-face course versus those in the online course. These results were not consistent with those found by Johnson et al. (2000) and Summers et al. (2005). However, Summers et al. (2005) discussed the idea that technology has the ability to greatly influence an online course simply by choosing technology that will enhance the curriculum of the course. Since online students have expressed attitudes that are very similar to that of face-to-face students, the instructor for this course has adapted technology in order to meet the needs of the learners. These results could indicate that the course instructor was the same for both the online

and face-to-face versions of the course, thus there was greater congruence between course versions.

Recommendations for instructors include facilitating activities that promote a positive learning environment and creating activities that allow students more freedom to explore their interests, while still accomplishing the same learning goals. In an effort to create activities that allow an extension of thinking, but are not entirely open-ended, instructors may try directing the focus of students by offering potential areas to explore, or experiments to perform, but giving students freedom to choose within the guidelines. By doing this, there is an element of open-endedness, but not too much that students may develop less favorable attitudes toward the classroom.

Although it may not be feasible to provide better laboratory facilities, instructors should make better use of the facilities available to accomplish the goals of the course. In instances where facilities are not available, activities should be created that promote learning in the same manner. These activities should be hands-on, but may only be a simulation of an experiment that could be performed in the laboratory. Experiments and activities do not have to be elaborate in order for student learning or integration to occur, but they should present the information students are learning in an additional format so that the student will be better able to comprehend the material.

Overall, an instructor should set goals to increase the level of integration between the lecture and laboratory portions of the course. When courses coincide students are able to make connections between the information presented in each course. In order to do this, an instructor should format the laboratory in a logical order that follows the order of the information presented in the lecture portion of the course. As students cover material in lecture, they will be applying that knowledge in their laboratory course. Instructors in the lab should consistently reference the information presented in the lecture portion of the course so students are better able to assimilate information.

In the future, this study should be replicated with a larger sample and in different subject areas. Both hard science laboratory courses (e.g., chemistry, physics, etc.) as well as applied science laboratory classes should be evaluated. The researcher should obtain achievement scores at the semester end to determine if student achievement is affected by the perception of differences in the actual and preferred classroom environment. In order to more adequately evaluate the integration scale, information should be obtained about the instructor for each lecture course. Further information of the curriculum can provide insight into the presentation order of material as well as the depth to which each topic is covered.

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Technology Integration in an Agriculture Associate's Degree Program: A Case Study Guided by Rogers' Diffusion of Innovation

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Abstract

Using Rogers' Diffusion of Innovations as a model, the researcher examined technology integration and how the faculty in an Associate's Degree program chose to integrate technology into the students' experiences. This case study explored technology integration from a programmatic standpoint using video collection, observations, qualitative interviews and video coding using Noldus Observer©. Video observations were collected on 96 students and two faculty members; interviews were conducted with 10 students, two faculty members and the program director. The data illustrates that faculty are careful when choosing to integrate technology. They consider the priorities of the program leadership team, technology usage in the agriculture industry and students' comfort with technology when making decisions about integration. The researchers recommend that technology be integrated on a daily basis and be evaluated as a teaching tool; however, technology is not a substitute for an actual teacher.

Introduction/Conceptual Framework

Students in any educational setting need to learn how to integrate and use technology to be successful in a future career. These technologies may include using a word processor, troubleshooting hardware and software issues and using a search engine (McEuen, 2001). While any educational system cannot teach every skill, faculty can help integrate technology and model skills that students will need later in life. When faculty members require technology-based projects in their courses, they may help students develop a foundation of important career skills to draw upon in the future.

Diffusion of Innovation provides insight into the factors that may influence an individual to utilize a new technology for instructional purposes (Bennett

and Bennett, 2003). A growing number of universities are encouraging faculty to utilize technology in their teaching and learning to turn their universities into high-tech learning communities. *"Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system,"* (Rogers, 2003, p. 5). Innovation-decision experience is the *"process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea and to confirmation of this decision,"* (Rogers, 2003, p. 20). The process can be influenced by prior conditions, characteristics of the decision making unit, perceived characteristics of the innovation and communication channels.

Rogers (1995) discussed five attributes that impact the rate of adoption: 1) relative advantage, 2) compatibility, 3) complexity, 4) trialability and 5) observability. *"Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes,"* (Rogers, 2003, p. 212). Many change agencies use incentives to increase the rate of adoption. The primary function of an incentive is to increase the degree of relative advantage. This suggests a need to focus on the specific pedagogical advantages of the instructional technology over a more conventional teaching tool (Bennett and Bennett, 2003). Most instructional technologies are flexible and can be put to many uses.

The second attribute, compatibility, *"is the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters"* (Rogers, 2003, p.224). A faculty member may feel that the instructional technology is consistent with their values and philosophy of teaching

but needs to know how the technology will assist him or her in achieving his or her learning goals. In many circumstances, the introduction of instructional technology results in rejection by the faculty who do not account for the amount of time it takes to learn the new technology, or the resulting changes that are likely to shift their teacher-centered classroom into a learner-centered classroom (Bennett and Bennett, 2003). To help facilitate the change from teacher-centered to learner-centered, faculty development must evolve from teaching about a piece of technology to training faculty to use software in the learning environment (Rao, 1999, March).

The third attribute, complexity, “is the degree to which an innovation is perceived as relatively difficult to understand and use,” (Rogers, 2003, p. 242). The rate of adoption is slower with more complex innovations. Instructional technologies can be very intimidating for faculty if they perceive them as too complex. As a result, learning how to effectively apply new technologies to enhance teaching and learning can be slow (Lynch et al., 2002). Even if the technology itself is not perceived as difficult, it may be too time consuming for a faculty to learn. To ensure the fear of complexity does not become an obstacle, it is important to stress that the content and outcomes of the training will work with the skills and abilities of the faculty involved (Bennett and Bennett, 2003).

The fourth attribute, trialability, “*is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the installment plan are generally adopted more rapidly than innovations that are not divisible,*” (Rogers, 2003, p. 243). The greater the opportunity to try new things, the easier it is for faculty to evaluate and possibly adopt new technology. Trialability can be a challenge for many forms of instructional technology since they require faculty members to make substantial investments of time and energy to learn the basics of something new. It is important for faculty to try out new instructional technologies to form their own opinion of its use in their classrooms (Bennett and Bennett, 2003).

The last attribute, observability, “is the degree to which the results of an innovation are visible to others,” (Rogers, 2003, p. 244). If the technology has a high rate of observability, it will be easier for a faculty member to learn about it, form an opinion about its potential benefits and uses and then make an informed decision about whether or not to begin adopting it into their courses. Observability indicates how critical it is to provide demonstrations to faculty to help them become familiar with it, ask questions about it and see it in use (Bennett and Bennett, 2003).

Current college-aged students are heavy users of the Internet, compared to the general population (Jones and Madden, 2002). Use of technology and the Internet is part of college students’ day-to-day activities and it is integrated into their daily communication habits (2002). Today’s college students check their email at least once a day, consider the Internet their personal library and treat technology as a way to express themselves through email.

There are nearly 14,500,000 students enrolled in colleges and universities across the country. These students have access to the Internet and other forms of technology at all times (Jones and Madden, 2002). The body of students currently in colleges and universities, known as millennials and were born after 1982, have been exposed to advanced technology and expect the integration of these tools in applications wherever they go (Howe and Strauss, 2003). This group of students views technologies such as text messages, mp3 players and web browsing as part of everyday life (Oblinger and Oblinger, 2005).

At the same time, educators across all age groups are becoming more comfortable with technology, choosing to integrate it into their own teaching. As colleges and universities begin to provide more support to their faculty, such as the Faculty Development Institute (FDI), faculty are able receive the support they need to implement tools more effectively and satisfy their students’ and their own learning objectives (Oblinger and Oblinger, 2005). Students expect their faculty to be technologically savvy and will draw opinions of their professors based on their ability to integrate technology into a course (2005).

As faculty work to integrate technology and continue to feel pressure from their students and the educational systems in which they are employed in to adopt new technologies. There are still questions about the impact of instructional technology on student engagement and the association that may exist between technology use in a classroom and student learning. Faculty members who are supported through training, tutorials and assistance with the integration of technology into their curriculum have been more successful at this task (Oblinger and Oblinger, 2005). However, little is known regarding how much technology should be infused in a class and where it is the most appropriate teaching tool to assist students’ with the curriculum they are learning. If technology is going to help or hinder education, one must take a closer look at the matter to help faculty - both seasoned and new - make informed decisions on what kinds of technology are necessary, as well as beneficial, to support the education of students in a collegiate system. Universities interested in adopting new technologies

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may want more data on the effectiveness of their current technology integration strategies.

What Is Technology Integration In Higher Education?

Technology integration is the use of computers, interactive media, satellites, teleconferencing and other technological means in instruction to support, enhance, inspire and create learning (Larson et al., 2010; Redman and Kotrlik, 2004). In 1995, the Office of Technology Assessment reported that schools had made significant progress in implementing technology and helping teachers use basic technology tools; however, schools were still struggling to integrate technology into their curriculum (Kotrlik, 2003). Technology can help students meet higher standards and promote innovative approaches to teaching and learning that were not available before, but many faculty still struggle.

Diffusion of Innovation

Diffusion of innovation is a theory of how, why and at what rate new ideas and technology spread through cultures (Rogers, 2003). The four parts of the theory of diffusion: the innovation itself, how information about the innovation is communicated, time and the nature of the social system into which the innovation is being introduced all work together to affect the adoption of an innovation. Diffusion is the adoption of an innovation which then gains acceptance by members of a certain community (Surry, 1997). Diffusion relies on how these factors and other factors interact with one another to help or hinder the adoption of a practice or product among a group of people (Surry, 1997). Diffusion of technology in an academic setting can change the habits of technology use in individual faculty but can take as long as five to ten years (Kershaw, 1996).

Diffusion is the process in which an innovation is communicated through certain channels over time to members of a social system (Rogers, 2003). Post-secondary education looks at technology for adoption in various forms (2003). Technology has two components: hardware, a tool that holds technology and software, the knowledge needed to operate the tool (Rogers, 2003). Faculty must be able to exhibit expertise when working with hardware and software in a class (Antonacci, 2002). Diffusion of innovation focuses on the reinvention of products and behaviors so they become a better fit for the needs of individuals and groups (Rogers, 2003). Kershaw (1996) states that developing a plan, creating appropriate organizational structures, providing support and training and promoting technology for a variety of purposes will help further the diffusion of technology integration.

The social system of an organization has a structure or pattern of arrangements within the system. In the setting of post-secondary education, the social system can revolve around the school system with administrators, faculty and students or in a larger setting of a community where an education program is situated. The structure of the social system has a set of norms or established patterns that have been pre-established (Rogers, 2003). Faculty can serve as change agents – a group of people who attempt to influence their clients, students, parents, administrators, or other faculty - to adopt an innovation.

Students can benefit from using an online environment because it can create a more flexible and convenient environment (Mayes, 2011). Faculty can work with the changes and adapt to the social system of the online learning environment as a way to enhance the interactions that the students have during their time in the program (Hirumi, 2002). Students can benefit their own learning by using this blended approach and using the technology as a medium to download notes, take quizzes and collaborate online during the evening, weekends and other times when class is not in session. (Mayes, 2011) Students can return to the classroom where they can collaborate with their peers and faculty leading the class and continue to use the online interface as an additional guide to help them understand and make sense of the information (Hirumi, 2002). By offering numerous outlets for receiving information, students learn that they can access information provided by the faculty outside of class time as a way to guide their own learning. Diffusion of technology integration will depend on the faculty and the rate at which they choose to adopt new hardware and software. Depending on the amount of support, training and time faculty have, the innovation may be successful in a short amount of time or take as long as ten years to be successfully implemented (Kershaw, 1996). As universities look to implement new technologies into their academic areas, they need to keep in mind that adequate support needs to be available in order for the diffusion to be successful.

The purpose of this study is to examine the phenomenon created when faculty choose to integrate various instructional technology tools into their instructional methods. The findings shared here are a part of a larger study conducted as a full program evaluation to examine the influence of technology integration on the faculty and the students in an associate's degree program within a college of agriculture. The integration of instructional technology tools into a classroom influences the relationship between the faculty and the students and has the potential to influence the students' comprehension of the course material. The major

questions guiding this portion of the study were: 1) how do educators decide what and how much technology to integrate in their program? And 2) what influences educators' decision to integrate technology?

Materials and Methods

To address the research questions, the researcher chose a triangulated case study approach. Using recorded video, in-class observations and interviews with the instructors and students, the researcher examined how the instructors integrated technology and how the technology influenced student engagement, motivation and learning. The use of multiple sources of data provides multiple measures of the phenomenon. Triangulation of data collection was important to help address the problem of construct validity (Yin, 2009).

This was a single-case study of an associate's degree program in a college of agriculture and life sciences in the eastern United States. Ninety-six students volunteered to participate in this study throughout the

course of the semester. Ten student participants provided feedback through recorded observations and interviews during the semester. Six of the ten students from the program were in their first year of the program while the other four students were in their second year of the program. All of the participants had the intention of either graduating or continuing their education at a four-year institution upon completion of the program. Each participant gave consent to participate in this study. This case did not propose to represent all students in one year of the program but instead focused on the program as it is conducted within the university. The intention of the interviews was to capture the "lived experience," of participants and their reactions to engagement with technology, their instructor and other factors that affect their engagement (Corbin and Strauss, 2008). The process of interviewing provided opportunities for both formal, structured interactions with the participants and informal conversation (Rossman and Rallis, 2003). The interviews provided rich descriptions of the ways students

Table 1. a Priori Propositions

Proposition	Supporting Literature	Research Question	Interview Questions	Observation Guide
Teachers decide to integrate technology based on their personal comfort level and accessibility to technology.	Computers can serve as a valuable and well-functioning instructional tool for school and classrooms where teachers have convenient access, are adequately prepared, and have some freedom in the curriculum (Ertmer, 2005). Instructional tools can be defined as, "anything that encompasses all the materials and physical means an instructor uses to implement instruction and facilitate students' achievement of instructional objectives," (Doolittle, 2010).	How do teachers decide what and how much technology to integrate and what influences their decision to integrate technology?	Describe your definition of technology. Describe your definition of technology integration. How do you decide what technologies to integrate when you're designing your class? How comfortable are you with the technologies you integrate? Who do you ask for help when you're struggling with the technologies you use in your classes? Where do you go to view new technologies you might want to use in your field?	How does the professor interact with technology? What behaviors does he exhibit when he's teaching with technology? How do those behaviors differ when there is no technology involved? What is the nature of the learning environment? When the professor is interacting with students, does he refer to technology?
Integration of instructional technology affects a students' engagement level in a class and motivation during class time.	Engaged students are more likely to learn, to find experience rewarding, to graduate and pursue higher education (Marks, 2000). Students consider technology essential to their education and say that their learning is based on motivation and without teachers; their motivation would cease to exist. (D. Oblinger, Oblinger, J. , 2005).	How does technology integration influence student engagement and attention span?	Describe your definition of technology. How does this professor integrate technology? Based on the above answer, do you feel as though the technology helps or hinders the delivery of the course content and why? Do you find it helpful in learning course content? Why or why not? What factors help you stay engaged and motivated in this class? Whom do you ask when you need help with technology?	What do students do when technology is used during the class? What non-verbal or verbal cues do students use when the teacher discusses technology (related to a Scholar site if there is one)? What do students do when technology is not used during the class? What cues does the professor use to motivate students? (language related to grades, learning, etc...) What kind of response do students exhibit when the professor refers to an upcoming assessment or assignment?

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engage in cognitive processes that could not be done through pure quantitative analysis (Rossman and Rallis, 2003). Observations, as defined by Rossman and Rallis (2003), included “formal, structured noting of events, activities and speech...and participant observation,” (p. 172). These methods allowed the researcher to observe the flow of the classroom and the interaction taking place between the instructor and the students during class time. The researcher was able to observe the relationships that formed between the instructor and the students throughout the course of the semester to determine if these relationships had the potential to influence the students’ engagement levels.

A case study was applied in an effort to understand the in-depth, real-life phenomenon over a period of time, to try and gather meaningful data that might not be achieved in one interview or isolated incident (Yin, 2009). Yin (2009) explains that case studies are used to, “contribute to our knowledge of individual, group, organizational, social, political and related phenomena,” (p. 4). An additional strength of case studies, when compared to other research methods, is that a variety of evidence is provided through an array of techniques, such as interviews, observations, or document analysis (2009).

The associate’s degree program was selected after the researcher met with the program director and learned about the level of technology integration utilized as part of the instruction in all program courses. Faculty members in the program were selected based on their willingness to participate and their desire to conduct research to gain feedback about their use of technology and teaching from their students. The Institutional Review Board approved the study protocol and all participants provided written informed consent prior to participation in the study. After receiving IRB approval (10-1084), participants were sought from within the program to volunteer to be videotaped during each course section meeting – twice a week – and to participate in four interviews throughout the semester. Cameras were set up before each class to record the class as a whole and web cams were attached to lap top computers to record individual participants who gave consent to participate. Video was collected from the students’ computers once a week and stored for analysis. The instructor offered the option of extra credit or coffee cards from a local coffee shop for those students who participated and as a research team. We honored their request.

Students were solicited during the first class session and presented with the purpose of the research, consent forms and given the opportunity to ask questions. The researcher and professors were both in attendance to answer questions. The only criterion for student selection was that they were enrolled as either a full- or part-time

Table 2. Observation Guide

The purpose of observations is to learn how an instructor engages students with technology and how students engagement and motivation
During class, the following constructs will be used to guide the researchers’ observations.
How does the instructor keep students engaged and motivated using technology?
a. What technology does the faculty use in the classroom?
b. How does he engage students to begin class?
c. Does the faculty offer support or help for students who are having trouble using the technology?
d. What solutions does he offer?
e. What behaviors does he exhibit when he’s teaching with technology?
f. What is the nature of the learning environment?
g. When the professor is interacting with students, does he refer to technology?
What are the students doing while the instructor is teaching the class?
a. How do students engage in the classroom learning process using technology?
b. How are students using technology and what effect is it having on their engagement and motivation?
c. What kind of response do students exhibit when the professor refers to an upcoming assessment or assignment?
d. What kinds of questions are students asking in class? (Something related to recall of information vs. mastery?)
e. What do students do when technology is used during the class?
f. What non-verbal or verbal cues do students use when the teacher discusses technology (related to a Scholar site if there is one)?
g. What do students do when technology is not used during the class?
h. What cues does the professor use to motivate students? (Language related to grades, learning, etc....)
i. What cues are students giving that demonstrate they are learning?

student in the associate’s degree program offered in the College of Agriculture and Life Sciences. The cameras were arranged to focus on and record only those students who gave consent. Students consented to be filmed and be interviewed. Students had the opportunity to decline if they chose.

The *a priori* proposition proposed in Table 1 was used by the researcher to the plan and develop the interview guide and observation protocol. Yin (2009) explains that propositions can, “reflect an important theoretical issue,” or provide guidance in, “where to look for relevant evidence,” (p. 28). Table 1 explains how the propositions are related to the participant interview guides and classroom observation protocol, as well as the supporting literature. The *a priori* propositions also provide linkages between the current literature, the research questions and the research practices.

Observations of the classroom took place over the course of six weeks. This time period allowed the lead researcher to follow the two classes of students and observe their interactions with each other, their peer group, their professor and the technology integrated into the course instruction and management. Observations took place each week during the classes and using the recorded video and observation guide in Table 2. The researcher kept a journal to record observations during the review of the classroom video and points to follow up on with the instructors and students during interviews.

Table 3. Interview Guide

<p>First Interview-Before classes begin Instructor Interview Guide How long have you been using this technology? What has changed? How do you/your dept. make decisions regarding technology use? What considerations weigh the heaviest or least? What feedback do you get from students regarding these choices? Whom do you ask for mentoring/help with a new piece of technology? How much time do you spend learning new technologies? How does this program make decisions on implementation? Describe your definition of technology. Describe your definition of technology integration. How do you decide what technologies to integrate when you're designing your class? How comfortable are you with the technologies you integrate? Whom do you ask for help when you're struggling with the technologies you use in your classes? Where do you go to view new technologies you might want to use in your field? How would you define learning? Do you view the technology you integrate as a tool to help your learning and understanding of the material? How?</p> <p>First Interview Student Interview Guide Describe your definition of technology. How does this professor integrate technology? Based on the above answer, do you feel as though the technology helps or hinders the delivery of the course content and why? Do you find it helpful in learning course content? Why or why not? What factors help you stay engaged and motivated in this class? Whom do you ask when you need help with technology? How would you define learning? Do you view the technology the professor integrates as a tool to help your learning and understanding of the material? How? Why do you think the professor chooses to integrate this technology? Are there other technologies or other ways of using this technology that you think the professor should be using or doing? Why or why not? What do you think the professor's objectives are for this course?</p> <p>Questions for Program Director Can you tell me some of the history of the program and how it evolved into what it is today? How do you/your dept. make decisions regarding technology use?</p>	<p>What considerations weigh the heaviest or least? What feedback do you get from faculty and students regarding these choices? Who does faculty ask for mentoring/help with a new piece of technology? How much time do you offer faculty for learning new technologies? How does this program make decisions on implementation of new technology? Describe your definition of technology. Describe your definition of technology integration. Describe the process a faculty would go through to get funding or support for new technology. Where do you go to view new technologies you might want to use in this program? How would you define learning? Do you view the technology you integrate as a tool to help your learning and understanding of the material? How?</p> <p>Second and Third Interview Instructor Interview Guide How do you think this course is progressing? What do you see as the strengths of this course? What do you see as areas that need to be improved? What aspects of the technology do you think are going smoothly? Which areas of the technology do you think need to be refined? How comfortable are you with the technology you're using right now? How are you gauging student's engagement during class? What strategies do you implement to encourage student engagement and motivation for the course if you notice them faltering?</p> <p>Second Interview Student Interview Guide How do you think this course is progressing? What do you see as the strengths of this course? What do you see as areas that need to be improved? What aspects of the technology do you think are going smoothly? Which areas of the technology do you think need to be refined? How comfortable are you with the technology you're using right now? How would you define your engagement in this class? What keeps you motivated in this class? What strategies do you use to study for this class?</p> <p>A fourth interview can be administered if necessary and saturation has not occurred.</p>
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An interview guide (Table 3) helped the researcher recall and reflect on the curriculum material, the structure of its delivery and the technology used to deliver the lessons. Faculty and students were asked to participate in interviews at various points during the semester. The director of the program was also interviewed in order to allow him the opportunity to discuss the role of technology in the program and the technology integration expectations he has of the faculty who taught in this program.

Interviews with the participating students served as an opportunity to hear their perspective on a piece of video after it had been reviewed by the researcher. Students were asked questions regarding their behavior or lack of behaviors related to instructor engagement and the students' engagement during class. Interviews were semi-structured, meaning there was a general interview guide; however, at times what the participant said triggered another question or led to other areas of discussion. Semi-structured interviews helped increase

the richness of the data and allow the researcher to ask more questions as the participants divulge information on their view of technology and their instructor (Corbin and Strauss, 2008). All participants were assigned gender neutral pseudonyms and are referred in the masculine form throughout this work.

The director of the program and the participating faculty provided the researchers with access to documents about the history of the academic program and course materials that were distributed to students during the data collection and observations. Documents on the history of the program were evaluated to inform the researcher of the expectations of the program for the students and for the faculty. Documents collected from the courses were evaluated for content and to identify where the instructors supported or required the integration of technology into the courses. Faculty provided the researcher's access to Scholar, the course management site, to access these materials and any other resources that the faculty have made available to the students.

Data Analysis

Analysis took place by observing video, utilizing Noldus Observer©, to help find themes in the video of participants and the lab instructor and the transcripts of the interviews with the participants and the lab instructor. Transcripts were coded and codes were merged into themes. Triangulation of data collection is important to help address the problem of construct validity (Yin, 2009). Multiple sources of data provided multiple measures of the phenomenon (Yin, 2009).

Video served as an important dimension in this case study. The video capture process was unobtrusive and allowed the researcher make observations, take notes and listen to the class (Patton, 2002). Videos were analyzed and coded for use of technology, how often the instructor and students discussed the use of technology and what conclusions both groups decided on in reference to the use of technology in and out of the classroom. Upon completing the class recording, video was viewed on the student computers to look at particular students' behaviors or non-behaviors using Noldus FaceReader© and Noldus Observer©. Video was coded based on facial expressions and non-verbal body language. What the observer was not seeing was just as important as what they were seeing and this helped the researcher form interview questions and code video based off of a non-response from participants. During the actual class session, the researcher observed the class, making notes in a journal of observations and general notes on the rapport of the instructor and tone of the class on that particular day.

Express Scribe© transcription software and Atlasti© coding software was used during the transcription and coding of the interviews with participants and the lab instructor. Observations from the researchers' journal were also transcribed and stored for further analysis. Memos were created during the transcription process in order to make note of any themes and reactions as they arose. Memos helped the researcher stop and analyze codes early in the research process to help be aware of common themes among the different pieces of data (Charmaz, 2006). Observations and transcripts were analyzed to determine any patterns, frequency of codes, or code combinations that would help develop a rich and full explanation in response to the research questions (Yin, 2009). All participants were assigned gender neutral pseudonyms and are referred in the masculine throughout this work.

The process of coding the transcripts and documents was informed by the *a priori* propositions, participant statements and the researchers' observations of the phenomena (Constas, 1992). The preliminary codes were reviewed by the researchers throughout the

process of analysis to “differentiate one category/theme from another and to identify properties and dimensions specific to that category/theme” (Corbin and Strauss, 2008, p. 73). Similar codes were then merged into one category (Glaser and Strauss, 1967/1995). Upon completing of the coding and category development, all quotes and codes within each category were reviewed to verify consistency within the category and accuracy of the category itself. Those quotes that were miscoded were reviewed and recoded. Once the categories and associated quotes were reviewed for their accuracy, the categories were integrated again into category themes. This paper reports the findings within one category theme and its associated sub-themes.

Results and Discussion

The purpose of this research is to examine the phenomenon regarding how much technology should be infused in a class and where technology use is most appropriate to assist students' with the curriculum they are learning. The major questions guiding this study were: 1) how do educators decide what and how much technology to integrate in their program? And 2) what influences educators' decision to integrate technology?

Theme: Technology Is Integrated and Diffused to Students Based on the Faculty's Program and Course Design Decisions

Sub-theme: Program. Technology use and integration is an expectation of the faculty when they are hired, as well as of the students when they accept admission into the program. The program director, Quinn, said, “*This program is one of the programs that really loves technology. The instructors are really comfortable with it and they have good skills applying technology.*” Through monthly faculty meetings and informal conversations with each other, faculty members are expected to know how to use and implement technology on a daily basis. This communication framework for developing plans for the integration of new technology begins when an individual is hired to teach in the program and the direction of the planning integration comes from the faculty meetings, where open communication and feedback for an exchange of ideas are welcome. Suggestions for new technology or review of a current piece of technology are discussed during the meetings and faculty work together to make decisions regarding the program. Quinn tries to support the faculty decisions to add new technology tools with funds for purchases and professional time for training. As a part of the discussion to add a particular piece of technology to a course, Quinn did not want to “overload the students applying the technology.” Once a piece of new technology is selected for implementation, the

program director works with the faculty to assess their needs on technology, whether the request is a new piece of software, additional training, or financial support to help offset the costs associated with integrating technology into the program. For example, a faculty member, Jessie, suggested that the i>clicker® could be a valuable tool for implementation. Quinn offered to support the faculty member if he invited a representative from the company to provide training to the faculty. Training was administered to the faculty in the fall of 2010 and Jessie began integrating them with his students in the spring of 2011 as a pilot, to see if other faculty members in the program wanted to implement them in future semesters.

Faculty are encouraged to seek help for integrating new technology resources from the university's Faculty Development Institute (FDI) to enhance their technology skill set and become familiar with new resources. To help save money, Quinn requires that each member of the faculty work through the FDI to earn a free computer by attending a series of professional development workshops. Each instructor completes training every three years to ensure that he or she receives an up-to-date computer. Quinn encourages his entire faculty to use FDI and also attend workshops they facilitate for faculty and staff in the program as part of their own professional growth. Quinn cites FDI as a major contributor to the success of the program, partnering with them to obtain grants and test new software. Quinn explains his rationale for using FDI as a main resource for the program:

"If it is expensive, I will find other resources, go to FDI see if there's budget there and a small grant that I can apply for. It means use the resources you have on your own and after that see what others have, but it's important to begin with a consensus among the faculty that yes, it's important, let's go for it. This is how we start."

The university moved from Blackboard® to Scholar® for the start of the 2010-2011 academic years and participation in the FDI training was making it a smooth transition. Faculty members were urged by Quinn to attend FDI workshops about Scholar® and he set the expectation that they would attend one or two workshops before their annual evaluations. Quinn worked to accommodate his faculty members' schedules and needs by organizing training times. Quinn completed all of the FDI courses so he could facilitate them and help faculty make the transition from Blackboard® to Scholar®. Practical training sessions were offered once a month with the faculty as a group after. Quinn recognized that if the faculty were comfortable and acclimated to Scholar®, teaching the students to use it would be less of a challenge. Faculty would be able to manage their courses, answer student questions and troubleshoot their own Scholar sites.

Sub-theme: Faculty. The program administrator spends time training faculty to be comfortable with the technology, supporting them with funds and helping them complete trainings through the Faculty Development Institute (FDI). FDI represents this institution's attempt to focus on the knowledge and skills required by faculty in order to meet today's students' needs for fluency in using information technology (Oblinger and Oblinger, 2005). The program administrator makes sure faculty know that technology use will be an expectation when they are hired and is clear in conveying his desire to integrate technology and its necessity to help students learn it before they graduate. By integrating their pedagogical, content and technological knowledge into their curriculum, the program has evolved into a partnership between the technology and the content. The two have continually evolved and been driven by newer content-related ideas or by new technologies. Students see this as an asset to have and even if they are not heavy technology users in their day-to-day responsibilities after graduation, they see it as a lifelong skill.

Jessie joined the faculty part-time in 2000 and became full time faculty in 2005. When he began teaching in the program, there was no technology or computer requirement. Since then, the technology requirement was set in place and Jessie has noticed that students have a greater comfort level with the technology when they arrive in the program as freshman. Jessie identified himself as an early adopter of technology:

"I'm probably more the early adopter kind of person than the other ones in the group, so if it works here and they have to have it, I'm sure somebody else will be trying it in their classes and I'll expand it to a couple of classes in mine, once I figure out, sort of get a handle on this....just try it and go, try and make it go, it seems like a really neat idea we can do a lot of things with it, let's give it a shot. I'm probably more inclined to that than other ones in the program."

Jessie views technology integration as something that makes his life easier, whether it's his teaching or application in the agriculture industry. He considers multiple sources before choosing a technology, including professional development conferences, speaking with colleagues and talking to FDI staff. Jessie said that word of mouth is sometimes his most powerful indicator so, if he "hears people say things often and read about something coming in" to the agriculture industry he will usually use an Internet search engine first to find out more information about a resource, then continue to ask questions through contact with a company, conversations with Quinn and finally the faculty of the program.

Jessie continues to adopt and adjust to technology in his classroom. For example, when Jessie introduced

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the use of i>clickers® in the spring of 2011, he worked to make adjustments to his material and incorporate opportunities for students to give feedback on their content knowledge so he can assess areas they in which they may need review or more information. Jessie was first exposed to the i>clicker® from an FDI training sessions where other faculty from biology and chemistry were integrating them into their courses. Jessie presented the idea to the rest of the faculty and received support to begin using them in his course. Jessie recognized that using PowerPoint© did not allow for much movement within a large classroom that was at capacity with students and wanted to incorporate something else as a way to gain students' attention and engage them in the material.

Emerson joined the faculty in 2007. Prior to being hired as an instructor, Emerson began his own business, which he still operates. Emerson cited his use of Microsoft Word and Excel as the primary applications of technology in his business. As a result, there was an adjustment period for him when he began working for the program and he felt behind when he started. Over time, he said he felt better acclimated, more comfortable and more willing to do more with technology. Through his teaching and feedback from students, Emerson admitted that he has moved away from traditional PowerPoint© slides for student distribution and has moved to other instructional strategies to deliver content.

"In most of my classes I'll utilize things like study questions, review questions, study guides, example problems, class notes as word documents. If I have a power point it's probably something that's probably about three years old now because I haven't done a new one in a while and I haven't looked back with any regret on that. So that's been one big shift for me, saying 'wait a minute,' if I'm presenting information, I don't have to use this format and I'm probably better off using something like that."

Emerson does not view himself as an early adopter of technology. He defines himself as "practical" and "apprehensive" when discussing his technology use and adoption. Emerson views technology from a utilization standpoint and wants to know he is using it for practical purposes. He explains:

"Yes, I'm very practically minded, so if I don't think technology is useful I don't do it just for the whiz bang of it; I don't do it just because it might look cool or might have some sort of appearance. It has to have a practical utilization for me to do that. How I use it is what I can do to transmit the information I have to the students."

Emerson recognizes that not all of his students love technology. He understands that students need to be familiar with computers and other technologies before

they graduate from the program, so he works to introduce them to email, Microsoft Excel spreadsheets and skills in online etiquette, such as sending a professional email. Emerson feels comfortable with the other faculty and sees the faculty meetings as an opportunity to discuss what they would like to start or stop doing in terms of teaching, curriculum and technology. Emerson said that, "Quinn takes the lead on that (technology) to a certain extent and Jessie has been innovative on the i>clicker®." He is not opposed to using technology if he can find it to be useful to his students and help fulfill a need for them.

Sub-theme: Students. Student feedback helps shape decision-making within the program. Feedback from the students serves as a valuable tool and faculty garner feedback in a number of ways such as a question on a test, through informal conversations, or from end of semester feedback forms. Current students in the program feel comfortable with the faculty and consider their positive relationships with them due, in part, to the technology that they are asked to use as a part of their course work. Faculty members consider technology a key in the student's success after they graduate and enter the workforce or continue their education. Students who enter the program come with the mindset that they are in the program to complete it, be successful and enter the workforce.

Kris, a first year student in the program understands why the program asks him to integrate technology: *"because they know that right now in our society technology is taking over and they want us to be ready for the future. To possibly start my own business or start working for a business and we know how to do things correctly so that way we don't get in trouble with our taxes or anything like that."*

Quinn notes that only about ten percent of the graduates decide to enter the four year program at the university or transfer to another university to seek a bachelor's degree. Students who enter this program are looking to return to a family business or enter an agriculture-related field upon graduation. Teaching students how to think independently and solve problems, such as those associated with adapting to new technology begins during the first days students are on campus. Students spend the first day of classes immersed in learning how to function at the university and begin using the laptop computers they were asked to purchase as part of the program. Quinn teaches all freshmen in a computer applications class on the first day of fall classes. The entire faculty is on hand as Quinn leads the new students in accessing university accounts, using the course management system, downloading and installing programs and troubleshooting their own

technology problems. Students can always ask Quinn or any of the faculty questions; however, Quinn is trying to emphasize to the students the importance of being able to solve technology problems for life after graduation. Quinn explains his rationale for structuring the first day of class:

“I’m at the point where I feel that the students will be responsible when they purchase their computers. They need to be able to maintain their computers and know how to handle it if they have problems. I think we are delegating the responsibilities to them because this is what is going to happen after two years in the program. There’s not a faculty available to fix their computer. They have to know, if they have issues, how to fix them.”

Students say that this is a helpful way to begin the program. Jamie considered the training helpful because he did not have a computer background before coming to college and had relied on his parents to help him. *“If it didn’t plug into the wall, it was broken. Coming here made me more independent and made me think, ‘oh, I can do this.’”*

Students consider Quinn to be an expert on technology and nearly all of the participants cited him as the “expert” that they turned to first if they were having trouble with their computers. Some attributed this to the fact that Quinn taught their introductory computer applications course, while others considered his helpful nature and willingness to take time with them individually. Rory, a first year student enrolled in the program said he would go to Quinn because he was willing to help anybody and he liked the one-on-one help he received. Students found the entire faculty to be helpful and available for them if they needed it, saying they could ask “pretty much anyone” and “if one (faculty) wasn’t available, another is.”

Graduates of the program were contacted for their feedback regarding how the use of technology they learned in the program now that had graduated and entered the workforce or continued their education. Quinn tries to seek feedback from graduates every three or four years. In 2010, graduates were contacted to seek information regarding the long-term application of the functions of the tablet computers they were required to purchase as part of their enrollment in the program. Quinn said, “I was concerned, with the economic situation, that the tablet pc prices were higher than a regular laptop.” Graduates responded to a survey about their tablet computers and Quinn found that while graduates liked them during their studies in the program, they were expensive and not being utilized to their full capacity following graduation. Quinn and the faculty made the informed decision to no longer require tablet computers and moved to the same laptop requirement that the rest

of the university had set for the incoming students in the fall of 2010. This saved the students approximately \$500 when they purchased a computer.

Second year students, who began in the fall of 2009, had mixed feelings on their tablet computers. Ashton said, *“I love being able to have the tablet because I could do assignments with my pen; it was convenient. I’m kind of glad that the program made us buy it because that way I had to get it and now I have a nice computer that I can have forever. I think it was a good investment and I’ve gotten my money’s worth out of it.”* Taylor felt that the tablet computer “got more in the way because of the electronic part with the electronic writing.” He felt it was easier to write things on paper.

The faculty is willing to try any piece of technology and software or take the advice of the agriculture industry to expose students to something new before they enter the workforce. The program administrator said he worked closely with the industry and communicated with past graduates about their feelings about technology integration and how it had been helpful for their ability to obtain and keep a job post-graduation. The faculty works to diffuse instructional technology by addressing the multitude of factors that influence the adoption of innovations to better explain, predict and account for the factors that will impede or facilitate the diffusion of technology to the students (Surry, 1997).

One example of the partnership with industry was illustrated when Quinn shared that the students enrolled in the landscape program would begin earning training and accreditation for a new piece of software. Working with the landscape instructor, he would be funded to attend the training and certification and diffuse the software to the students during the course. This would allow the students to learn the software and receive an additional certification upon completion of the program, hopefully giving them an edge in the job market. The program will be tested for two years and be evaluated based on the students’ ability to improve their landscaping skills set and employability. At the end of the two year trial, the faculty and program administrator will make a joint decision to decide whether or not to continue allocating funds to the accreditation. If the program is not successful, funding will be stopped. The program administrator is not afraid to start or stop a program if there is consensus from all of the stakeholders and Quinn shared that the priority of the program is the student and how it will be beneficial for future employment.

Program recommendations. Technology and technology integration should not be viewed as a convenient way to educate students or a default when educators run out of time during class. Students want to integrate technology as a way to help them acquire

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a better job, prepare them to be more competitive for internships and increase the skill set they take with them after college. Based on the findings in this study, there are a variety of improvements that could be made to enhance the appeal and rigor of technology integration in the higher education classroom. As educators, there are recommended strategies that would create more effective learning experiences for students. Students wanted to see more variety in accounting and management software, with more time spent on learning how to manage a business from the financial standpoint.

Through student feedback and analysis of video, it is recommended that the course management tool, Scholar©, be organized by individual faculty to help streamline the site for students. Each faculty member had different active options in Scholar© for students and this made it confusing. Students take courses from each of the faculty multiple times in their two years of education, enabling them to get to know their teaching style and their preferences with technology. Faculty should capitalize on this and work to streamline their technological offerings so students will know what to expect when they open Scholar© pages from the same faculty. Students noted that some faculty used one particular aspect of the course management site, but failed to keep it updated while other faculty had their site so overpopulated with resources that it was difficult for students to find the ones they needed to keep up with the course. Student feedback revealed that there was no consistency among the courses taught by each faculty member, making it difficult to find any common organizational pattern and causing confusion for the students.

It is recommended that faculty begin utilizing the Scholar© chat function both in and out of class to engage students who were less likely to answer a question verbally. This would help engage all of the learners through multiple contexts and make students less likely to browse the Internet for fun during class time. The chat function can be used to offer online office hours so students may ask questions at their convenience. Chat office hours could be implemented regularly or before major deadlines to help faculty reduce the number of individual emails if they receive from students.

The forum or discussion board function may also serve to be a valuable asset to the program. Faculty can ask questions before class to gauge what kind of pre-existing knowledge students possess and to deliver a pre-test to prepare for upcoming material. Forums can be a good place to discuss questions that the majority of the class may have or ask them to think about and discuss topics that are not on the syllabus, but still relevant to the material. Examples could include current events,

ethical issues, or trends within the industry that is being studied.

Summary

The purpose of this triangulation qualitative case study was to investigate the phenomenon of technology integration in a post-secondary educational setting and how the faculty of the academic program made technology decisions, and adopted new technology. College-aged students enrolled in an Associate's Degree program served as the case study group. Over the course of the case study, participants engaged in the use of a variety of learning technologies. While some participants had more prior experience than others, for many, this program provided full immersion, from both the faculty and student perspective, in using technology on a daily basis.

Triangulation of qualitative methods connected data derived from classroom observations, coded data from Noldus Observer©, qualitative interviews and document analysis. As the program has evolved since its first class in 1987, the leadership has helped guide the program through changes in program offerings, courses, and technology changes. Universities are making sizable investments in technology to improve learning in order to make students work ready; however, faculty are either simply not using the technology or not using it effectively (Kershaw, 1996). The program has been successful at adapting to meet the technology needs that the agriculture industry requires for students to successfully gain future employment. As reported in other studies, the faculty have managed the change effectively to be successful in integrating technology (1996). The agriculture industry looks to the program to hire new graduates with the knowledge that they will be well prepared to work in that field.

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Perceptions of Food Safety and Curricular Offerings¹



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Abstract

Students in an introductory microeconomics course were surveyed to determine their level of awareness of what comprises the field of food safety, a university's food safety program and the demand for food safety graduates and their level of interest in learning more about a degree in food safety. There was considerable ignorance among student respondents about the availability of a food safety degree and diversity of thought regarding potential courses required for the degree. The students were surprisingly accurate in their top-of-mind definitions of food safety. Just under one-third of respondents mentioned each of the key areas of procedures/processes to ensure safety of food, food properly prepared and processed and food free of disease/contamination. Respondents in general were not interested in learning more about a degree in food safety. Nor were they particularly well versed in potential careers, with many respondents mentioning jobs that in general do not require post-secondary education and would generally include firm-sponsored on-the-job training.

Key Words: Food safety, curriculum, recruitment

Introduction

Growing concern for the safety of our food supply led to the development of a national food safety initiative which affects every aspect of the food chain, from farm to fork (North Dakota State University, 2010). In response to the resultant growing demand for food safety expertise, increasing the number of graduates with food safety education has become a priority for institutions in the Upper Great Plains. Currently, North Dakota State University (NDSU) offers BS, MS and PhD. degrees in food safety, as well as an undergraduate food safety minor. NDSU appears to be the only university offering

an undergraduate major in food safety although other institutions offer certificates and graduate degrees in food safety. Michigan State University offers a food safety specialization for MS students in a variety of departments, as well as an MS in food safety offered through the College of Veterinary Medicine. The latter is primarily offered through on-line courses. Kansas State University offers an MS degree in Food Safety. An inter-institutional certificate in food safety is offered through Great Plains Interactive Distance Education Alliance (GPIDEA) via cooperation between Iowa State University, Kansas State University, the University of Missouri and the University of Nebraska. South Dakota State University (SDSU) offers an undergraduate minor in food safety.

Few degree programs in food safety combined with low student numbers in existing programs is of concern. Thus, collaborators at NDSU, SDSU and the University of New Mexico applied for and received a USDA Challenge Grant award with the overall goal being to expand student numbers and involvement in food safety academic programs, with a particular focus on under-represented groups including Native American and Latino populations. The focus for NDSU is on recruitment and retention.

Increasing the number of students graduating with training and experience in food safety calls for a planned process for recruitment, retention and graduation (Huddleston, 2000). One component of this process is to research enrollment and retention trends. Another component is the development and implementation of a marketing plan to inform students about academic programs in food safety and provide to them a value proposition to participate in these programs. Baseline data is necessary and will serve as a springboard for the development and implementation of marketing plans designed to increase enrollment in academic programs.

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Enrollment has remained relatively low in both the undergraduate and graduate programs in food safety at NDSU. Contributing factors may be lack of student interest in, or awareness or understanding of, the programs and related career opportunities. To provide a baseline from which to judge effectiveness of recruitment strategies, data was collected on students' current knowledge of food safety, composition of a food safety degree and careers in food safety, interest in a food safety degree and intent regarding an academic program in food safety.

Materials and Methods

A survey was conducted to gather the aforementioned baseline data. The survey was administered online via the Blackboard survey tool to students completing an online course entitled Introductory Microeconomics. It was available for students to complete during the last two weeks of fall semester 2007. Students were offered 10 points of extra credit for completing the survey, which could raise their grade by approximately one-half of one percent.

Knowledge, Education and Careers. Most research efforts to assess knowledge about food safety use measures such as performance on an assessment instrument that asks factual questions about food safety processes (e.g., proper refrigeration storage temperature). In this exploratory research we rather elicited top-of-mind definitional responses to gain an understanding of student perceptions of the field of food safety. Understanding of food safety was measured by participant responses to two questions: "What do you think of when you hear the term food safety?" and "At what point(s) in the food marketing channel do you think most food safety concerns arise?" For the latter question, students were first provided with the following information: "*The food marketing channel runs from the farmer producing a commodity (e.g., cattle, lettuce) to the end consumer eating a meal. In between are firms that process, transport and sell commodities and food.*"

Awareness of food safety education was measured in two ways. First, participants were asked to "*try to imagine courses, other than those in general education, a student would take to get a degree in food safety.*" They were asked to list at least four courses that might be required. Next, students were asked to respond to the question "Does NDSU offer an undergraduate degree in food safety?" Perception of food safety careers was also measured. Participants were asked to indicate their outlook on employment opportunities for food safety graduates. They were also asked to list at least four specific jobs that would require some coursework or experience in food safety.

Interest. Student interest was measured by responses to the question "What is your level of interest in learning more about a degree in food safety?" Students were asked to indicate interest on a scale of 1 (not interested at all) to 8 (very interested). Responses were collapsed into three categories of: not interested (based on a response of 1, 2 or 3), neutral (based on a response of 4 or 5), or interested (based on a response of 6, 7 or 8).

Demographic questions included major, gender, class and population of the town nearest to which they grew up. Students were also asked to identify the two most important factors that influenced their choice of major. Before data collection, permission to conduct research with human subjects was granted by the Institutional Review Board (IRB) at NDSU. Of the 43 students enrolled and actively engaged in the Introductory Microeconomics course, 38 completed the survey for a response rate of 88%. Twenty-one students were male. Five students were freshmen (13%), four (11%) were sophomores, eighteen (47%) were juniors and eleven (29%) were seniors. A diverse set of majors was included among participating students. Fourteen students were in majors within the College of Business. Only three students held majors within the College of Agriculture, Food Science and Natural Resources, within which the food safety degrees are housed. An interest in the field was mentioned by nearly two-thirds of students (63%) when asked to indicate two factors that most influenced their personal choice of major. Thirty-two percent mentioned job availability and 18% indicated personal skill in their chosen field.

Results and Discussion

Participants were asked what they think of when they hear the term "food safety." Responses were categorized. There were 41 valid responses from 36 students (five students offered two responses). Thirteen students thought of the existence of procedures to ensure the safety of food. Twelve specifically mentioned the concept that food has been properly prepared or processed. Eleven thought of food that is free from disease or contamination, with two of those students more generally indicating food that does not make us ill. Five students specifically mentioned that food safety brought to mind government oversight. These responses by students in general concurred with definitions of food safety from the literature and other sources (e.g., government or organization publications to include the United States Department of Agriculture and the Food and Drug Administration). Representative of definitions is that from the Food and Agriculture Organization / World Health Organization, offered in Unusan (2007, p. 45), "*the degree of confidence that food will not cause*

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sickness or harm to the consumer when it is prepared, served and eaten according to its intended use."

Students were asked at what point in the food marketing channel they thought most food safety concerns arise. A majority of respondents perceived the point of origin of food safety concerns to be processing and transportation. There were forty-three responses from the thirty-eight respondents (five students offered two responses). Processing as the point of the greatest number of food safety concerns was mentioned by seventeen students, and transport was identified by eight. Only four identified the farm and only three the consumer (e.g., home preparation). Eight students indicated food safety concerns arise throughout the marketing channel and two mentioned the general idea of handling.

In the literature and popular press, it is in general reported that the origin of food borne disease outbreaks in developed countries is at the point of preparation. Points of preparation include at home and in commercial or institutional eating establishments. Haapala and Probart (2004) report that, in the majority of cases (79%), commercial or institutional eating establishments are implicated as the cause of food safety problems. Homes may comprise a larger percentage than is reported because food safety problems at home often go unreported or unidentified (Redmond and Griffith, 2003). The final point of preparation is key because it is almost impossible to guarantee pathogen-free food throughout the food marketing channel (Unusan, 2007).

Education and Career

Students were in general unaware that NDSU offered an undergraduate degree in food safety. When asked if NDSU offered such a degree, seven (18%) correctly indicated "yes", three (8%) indicated "no" and 28 (74%) indicated they did not know. Students did, however, recognize that the demand for graduates with a food safety degree exceeds supply. Thirty-one students (82%) indicated there was a shortage of food safety graduates, five (13%) indicated supply matched demand and only two thought there was a surplus of graduates. The reason behind the surprising result that students were aware of the existing shortage cannot be ascertained from the results.

Students were asked to name four jobs they thought required an employee to have some coursework or experience in food safety. Most commonly mentioned were those who work directly with food or food products, or their direct managers and food inspectors. Over half (20 students) specifically mentioned a chef, cook, or other food handler. Eighteen mentioned food inspectors or more generally a Food and Drug Administration or United States Department of Agriculture employee.

Seventeen mentioned a restaurant or food retail store owner or manager. Fifteen mentioned line-type employees in a food processing facility. Nine mentioned agricultural producers. Other mentions included a dietician/nutritionist (seven students), grocery store employee (six), butcher (six), transportation/truck driver (six), health/fitness professional (three), laboratory worker (two) and childcare worker (two). The number of students mentioning a quality control person was the same number mentioning a mom, surprisingly only one. The NDSU Food Safety Website very broadly lists as typical employers of graduates the food industry (including agriculture production through food service and retail), government agencies, academia and research institutions.

Interest

Interest in learning about a degree in food safety was mixed. When asked to indicate interest on a scale of 1 (not interested at all) to 8 (very interested), approximately half were not interested (those responding with a one, two, or three). Nine were neutral (response of four or five) and the remaining nine expressed interest. A similar percentage of students among those perceiving there to be a shortage of food safety graduates (26%) expressed an interest in learning about the degree as among those perceiving supply to match demand (20).

Comparatively, the literature reports relatively high levels of interest in food safety among middle school children (Abbot and Byrd-Bredbenner, 2008; Abbot et al., 2010; Haapala and Probart, 2004) and hospital food service workers (Ramsay and Messersmith, 2001). Haapala and Probart (2004) also reported that females were more interested in food safety than males. In the current study, level of interest among female students (4.71, 1 = not interested at all to 8 = very interested) was also higher than that of male students (2.81) ($p = 0.01$).

Curriculum

Students were asked to name four classes other than general education classes that would be included in a food safety curriculum. Thirty-five responded, all but one student mentioning at least four classes. The remaining three students indicated they had no idea. Approximately half (19 students) mentioned a "hard science" class such as chemistry or biology. Interestingly, students with a major in the "hard sciences" were no more likely to name "hard science" classes than other students and in fact only 37% of those with majors in the hard sciences did so. Fourteen students mentioned a class in food processing and/or packaging, with four of these students also mentioning a class in food transportation or distribution. Twelve students mentioned a nutrition class, while

eleven mentioned a class in health or wellness. Eleven mentioned a class in cooking or food preparation. Eleven students mentioned a class in agriculture (generally) or a specific agricultural field (e.g., animal science). Other mentions were food regulation/inspection (six students); law (four students); and food borne illnesses (four students).

At NDSU, the Food Safety curriculum is selected by the student and his or her advisor. Students must complete University general education requirements and nine one-credit modules covering a wide scope of food safety topics (Figure 1). Students then select their remaining classes, specializing in one of five areas. Three specializations (production, processing and science) are comprised of classes falling under the STEM (Science, Technology, Engineering and Mathematics) disciplines and another (retail/consumer) is comprised largely of food handling courses (Table 1). Alternatively, the economics specialization suggests only non-STEM

courses (e.g., Agricultural Economics, Communication). Flexibility in the curriculum accommodates one or more minors or a dual major.

Conclusion

There is considerable room for educating students about a degree in food safety and the careers available to food safety graduates. Student respondents were not very well educated on where food safety concerns most often arise in the food marketing channel, were relatively ignorant about the availability of a food safety degree and in general had an erroneous perception of what students graduating with a degree in food safety would target as career options. Their perceptions of required courses that would be included in a food safety degree were wide in scope and they were in general not interested in the degree. It is not clear if interest can be improved with information and education about the degree and its associated careers, but testing

this is a natural next step. There are clearly market segments of students defined by their interests and their perceptions of what comprises a curriculum in food safety and available career options. Recruitment efforts aimed at increasing student numbers in the program need to take the current level of ignorance about the program and its inherent flexibility into account.

This initial work is based on a limited sample size and will be expanded by conducting the survey in a wider variety of classes at NDSU, and to potential students at North Dakota high-schools and tribal colleges, the latter potential transfer students. Subsequent research will consider the value of intervention strategies aimed at increasing knowledge of and interest in a food safety degree and career.

Figure 1. Core Food Safety Courses at North Dakota State University (each one credit and offered on-line only)

- SAFE 401 - Food Safety Information & Flow of Food - An orientation to food safety. How to find, evaluate and report credible food safety information and comprehension of food systems.
- SAFE 402 - Foodborne Hazards - This course will lead students into the comprehension of the vast variety of chemical, physical and biological foodborne hazards.
- SAFE 403 - Food Safety Risk Assessment - This course will enforce the concept that no food is 100% safe and will lead students to understand how to assess the likelihood of foodborne illness events.
- SAFE 404 - Epidemiology of Foodborne Illness - This course will lead students to understand foodborne disease outbreaks, comprehend and apply epidemiologic models of disease causation and causal inference and apply disease outbreak investigation steps.
- SAFE 405 - Costs of Food Safety - This course will lead students to comprehend and analyze the economic and societal costs of foodborne illness outbreaks.
- SAFE 406 - Food Safety Crisis Communication - This course will lead students to understand the best ways to disseminate food safety information during or following a foodborne illness outbreak.
- SAFE 407 - Food Safety Risk Management - This course will lead students to understand strategies and costs of reducing risk of foodborne illness.
- SAFE 408 - Food Safety Regulatory Issues - This course will lead students to understand the food safety regulatory structure.
- SAFE 409 - Food Safety Risk Communication & Education - This course will lead students to understand the importance of worker training and consumer education in food safety.

Table 1. NDSU B.S. Degree in Food Safety: Courses recommended for students with potential emphasis areas

PRODUCTION	PROCESSING	SCIENCE	ECONOMIC / SOCIAL	RETAIL / CONSUMER
ANSC 222 Meat Animal Evaluation	ABEN 263 Biological Materials Processing	BIOL 440/640 Microbial Ecology	AGEC 375 Applied Agricultural Law	BUS 460 Consumer Behavior
ANSC 482 Sheep Industry and Production Systems	ABEN 458 Food Process Engineering	CFS 474 Sensory Science of Foods	ECON 472 International Trade	HNES 270 Consumer Issues in Food and Nutrition
ANSC 484 Swine Industry and Production Systems	ANSC 330 Meat Selection, Grading, and Judging	MICR 363 Clinical Parasitology	AGEC 484 Agricultural Policy	HNES 261 Food Selection and Preparation Principles
ANSC 486 Beef Industry and Production Systems	ANSC 344 Fundamentals of Meat Processing	MICR 452/652 Microbial Ecology	ADFH 411 Food and World Cultures	HNES 261L Food Selection and Preparation Principles Laboratory
ANSC 488 Dairy Industry and Production Systems	CE 410 Water and Wastewater Engineering	MCIR 453/653 Food Microbiology	COMM 433/633 Legal Communication	HNES 361 Food Production Management
MICR 465/665 Fundamentals of Animal Disease	CFS 430 Food Unit Operations	MICR 454/654 Bioprocessing	COMM 443/643 Mass Media and Public Opinion	HNES 361L Food and Production Mgmt Laboratory
MICR 475/675 Animal Virology	CFS 431 Food Unit Operations Laboratory	MICR 460/660 Pathogenic Microbiology	SAFE/COMM 485 Crisis Communication in Public Relations	HNES 460 Foodservice Systems
PS 110 World Food Crops (CCN)	CFS 480 Food Product Development	MICR 470/670 Basic Immunology	STAT 462/662 Introduction to Experimental Design	HNES 460L Foodservice Systems Laboratory
PS 360 Horticultural Food Crops		PPTH 460/660 Fungal Biology		

Perceptions of Food Safety

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Student Perceptions and Performance of an Online Tool Introducing the Concepts of Plant Breeding¹



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Abstract

There is a need to develop multimedia tools that can be incorporated into curricula to introduce the basics of plant breeding as a method to recruit and to encourage students to pursue plant breeding programs. To fill this need, we developed an online module that permitted the understanding of the basic techniques and concepts of plant breeding. The design of this study was pre-test and post-test descriptive and comparative, which involved the use of general knowledge instrument to gather pre-test and post-test data for measuring differences resulting from a treatment, which was the introduction of a “Plant breeding” module. In addition, student perception questions were collected. The target population consisted of all undergraduate students (N=133) enrolled in the College of Agriculture at Purdue University during the Fall and Spring semesters of 2010, as well as, the Spring semester of 2011. Students’ post-test knowledge scores were slightly lower than pre-test scores, even though the percent change was minimal. We found that this module was a beneficial tool for student-learning and recommended it to be used by faculty to simulate an authentic hands-on learning experience.

Key words: corn, online-module, plant breeding, sorghum, student-learning, STEM

Introduction

Developing well-designed learning materials improves both teaching and learning in an online environment (Capri and Mikhailova, 2003). As Stemler (1997) indicated, learning with multimedia “becomes

active, not passive and it ensures that users are doing, not simply watching.” Thus, creating well-designed online modules that includes the previous authors’ research is critical. Elliot (2007) provided an overview of how authentic learning can transform both student and teachers’ success.

The practice of plant breeding is one of the oldest disciplines in the world that has been applied with the goal to feed the human population (Kingsbury, 2009). This area of science is indispensable for the growing population with the environmental challenges that the world will face in the future years. Growing populations, urbanization and environmental factors like climate are affecting food security. This entire scenario has surfaced as we approached approximately a billion of the world’s population living in hunger (FAO, 2010). The need to expose new generations (post-secondary students) to the plant breeding discipline is essential to achieve future demand of food products, mainly in the plant science field (Wolinsky, 2010a). Based on Wolinsky (2010b), as the science has been reaching new accomplishments at molecular levels, genome sequencing and structure, the amount of students interested in plant breeding at the graduate school level has been decreasing. In addition, there is a need to encourage urban (non-agricultural background) students to be interested in this field of study that normally is unfamiliar for them since they are not exposed to agricultural careers. Moreover, the disciplines that consist mainly of laboratory bench work and computer analysis are usually more attractive to students compared to the plant breeding programs, which involves intense fieldwork (Wolinsky, 2010b).

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Student Perceptions

The number of students pursuing a plant breeding career at a higher education level is decreasing; especially at the master and doctoral degrees levels, while the world-wide demand for professionals in this career has increased (Bliss, 2007; Guner and Wehner, 2003; Morris et al., 2006; Gepts and Hancock, 2006; Repinski et al., 2011; Wolinsky, 2010b). Organizations such as the Crop Science Society of America have started mentoring programs such as the “Golden Opportunity Scholars” program to help recruit undergraduate students into the Crop Science disciplines, particularly those that might be interested in plant breeding (CSA, 2012). A normal classroom sometimes can fail to bring a broad scenario of field techniques and skills into the classroom because of lack of funding, expertise or even the season in which the course is taught. During the winter season in the Midwestern United States, teaching of field techniques and skills are limited by weather and climate. These fields’ techniques and skills have been rated as priority knowledge needed for this career according to plant breeders in diverse institutions and countries (Repinski et al., 2011). Repinski et al. (2011) surveyed plant breeders to determine the important knowledge categories needed in this career to supply the oncoming need for food sources. The results of the survey revealed three sectors: field design, technique and analysis and plant breeding methods for self and out-crossing systems. The teaching of this knowledge is complicated when the course schedule does not coincide with the growing season. Consequently, it is important to look for ways to introduce this discipline so that students with different backgrounds can be well prepared professionals and potentially understand plant breeding as a career. Thus, it is important for students to have an authentic real-world training experience related to the priority knowledge needed as stated by Repinski et al. (2011).

Using technology or multimedia in the classroom can be an effective way to introduce the content that demonstrates the element of the professional job in order to promote learning and recruitment of the next generation of future scientists. Elliot (2001) and Sparks (1994) indicated that the essential element of job-embedded professional development is that the learning takes place within the context of one’s daily work environment. In the case where the students experience the multimedia utilizing the plant breeding module, the students will encounter the professional job situation which

could be an attractive solution to promote learning in the “modular” work environment. This statement is supported by the findings by Rieber et al. (2004) who reported that students find that utilizing simulations to be effective in learning new content. Our objective was to develop a tool to introduce post-secondary students at the college level to the plant breeding discipline.

Purpose of Study

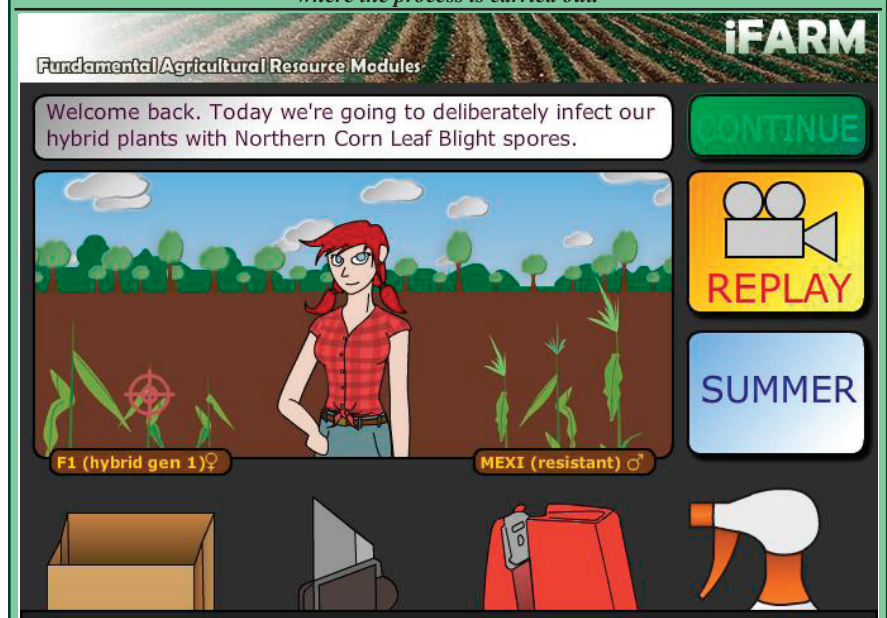
The purpose of this study was to investigate the plant breeding competence and perceptions utilizing an online plant breeding module to a group of college students who were enrolled in “World Crop Adaptation and Distribution” and “Crop Production,” undergraduate elective courses for both College of Agriculture majors and non-majors. The design of this study was pre-test and post-test descriptive and comparative, which involved the use of general knowledge instrument to gather pre-test and post-test data for measuring differences resulting from before and after the treatment, which was the introduction of a “Plant breeding” module. In addition, we collected student perceptions of their previous experiences with plant breeding as well as their opinions on the use of the module related to their career goals.

Materials and Methods

Design and Components

The authentic learning framework led to the development of the “Plant breeding” modular unit as part of the interactive tool called Interactive Fundamental Agricultural Resource Modules or “iFARM” (Unruh

Figure 1. Plant breeding iFARM Module Screenshot. In the top left part, a female breeder is introducing how to breed corn and in the bottom are the essential tools to perform the crosses. Top right is the bottom to view the video again and an indication of the season where the process is carried out.



Snyder et al., 2009) to introduce the practical techniques and “hands-on” skills of plant breeding in the field (www.ifarmlearning.com). The iFARM modules reflect real-life situations that can potentially enhance students’ skills and experiences.

The design of this study was non-experimental, pre-test-post-test descriptive and comparative, which involved the use of general knowledge instrument to gather measuring differences (Dimitrov and Rumrill 2003). The module was developed using Flash Professional CS5.5 establishing a field scenario for a plant breeder and the foundations of this profession such as crossing the crop plant, climate condition and tools used. The plant breeding modular unit consists of the introduction of different cross systems in two important commodities, corn (*Zea mays*) and sorghum (*Sorghum bicolor*). For each crop, the module explains the process of crossing and selection of plants carrying the desirable traits needed to enhance food production. After the students watch the explanation of the process, they have similar scenarios with all the tools necessary to perform their own crosses (Figure 1). The students were required to watch the two videos imbedded into the module of actual plant breeders doing the same procedures in the field.

Demography

This investigation was a descriptive census (all members of the class) study (Patton, 2002) and the target population was undergraduate students in the College of Agriculture. The target population consisted of 133 undergraduate students from two different agronomy courses during the Fall and Spring semester of 2010 and the Spring semester of 2011. Although the participants were not selected randomly because the investigation was a census study, students who completed the pre-test and post-test were considered to be representative of undergraduates who would have enrolled in these courses in previous semesters or will enroll thereafter (Oliver and Hinkle, 1982). These students represented five colleges with the majority from the College of Agriculture.

Assessment and Data Collection

Approval was obtained from the university’s Institutional Review Board and no identifying information was used in the data analysis. The pre-test consisted of five multiple-choice questions and yes or no questions that were provided before the iFARM plant breeding activity. On the pre-test they were also asked the following perception questions: (1) Are you familiar with the concepts with plant breeding? (yes or no); (2) Do you have any previous experience with plant

breeding? (if yes provide details); (3) I think learning about plant breeding will benefit my career objectives? (Strongly agree, agree, neutral, disagree, strongly disagree, and no opinion). Students spent 5 minutes on the pre-test, 30 minutes completing the worksheet, which contained several short answer questions based on previous experiences and learning (Table 2) and 10 minutes on the post-test. The post-test and pre-test consisted of five questions covering the same concepts formulated differently. The post-test also included the following perception questions and responses: (1) Do you believe that you have a better understanding of plant breeding after this module? (yes or no); (2) Did you find the directions easy to navigate? (yes or no); (3) Overall, did you find this activity useful in your learning? (yes or no and why); (4) I think learning about plant breeding will benefit my career objectives (Strongly agree, agree, neutral, disagree, strongly disagree, and no opinion)

All these exercises were graded and the answers were recorded in Microsoft Excel® to run statistics. Basic statistics and graphics were performed in Microsoft Excel® and t-test analysis was completed using GraphPad Prism version 5.00 for Mac OS X (GraphPad Software, San Diego California USA, www.graphpad.com.)

Results and Discussion

R1) What were the students’ levels of pre course and post course knowledge regarding plant breeding subject content?

The pre-test and post-test had five questions covering plant breeding such as plant breeding general concept, cross pollination, backcrossing, crop desirable characteristics and plant reproduction systems. In both the pre-test and the post-test the minimum points obtained by the participants was zero, a maximum points obtained was six and median was four points. We observed a slight decrease in the students’ scores from pre-test to post-test with the group averages of 4.06 (SD=0.899) to 3.43 (SD=1.579), respectively (Table 1). There was no statistical significance found after completing independent t tests of both the pre-test and post-test (Table 1). According to these results, we need to make modifications to our pre-test, post-test questions because post-test questions were more difficult following the module, because our expectations were higher.

Table 1. Independent T-Test of the Pre-test and Post-test (N = 131)

	Mean	SD	T-test	Sig. (2-tailed)
Plant Breeding Pre-test	4.06	0.89	50.32	.000
Plant Breeding Post-test	3.43	1.57	24.84	.000

Note. The pre-test and post-test scores were based upon a total of six points.

Student Perceptions

R2) What relationships existed between student's previous backgrounds enrolled in the courses and plant breeding competence (i.e., knowledge)?

Since we had a very diverse population with regard to plant breeding knowledge and experience, years in college and majors' careers, we wanted to classify the population and verify if the possible sub-groups and backgrounds could influence our results for this study. Based on our pre-test questions about familiarity with plant breeding, 43.8% of the students stated that they were familiar with plant breeding concept and 19.6% mentioned that they had previous experiences in plant breeding (Table 2). Another interesting fact for us to know was the students' interest in plant breeding relative to their potential careers, to understand the possible perception and attitude about this field of study. Therefore, we asked if they thought that learning about plant breeding would be beneficial for their career and 80.2% of the students strongly agreed and agreed that learning plant breeding would benefit their career (Table 3). Unfortunately, this question was not part of the assessments prior to the 2011 Spring semester. However, the responses from that class indicated to us that the majority of the students agreed that the plant breeding module could be beneficial to their professional goals. It supports how helpful a plant breeding module like ours could help students in their career development.

Table 2. Plant Breeding Opinion Question Responses Pre-Test (N = 133)

Question	Percentage
Are you familiar with the concepts of plant breeding?	
Yes	41.4
Somewhat	2.4
No	49.7
Do you have any experience with plant breeding?	
Yes	19.6
No	73.0

Table 3. Students' Response to Whether the Module will be Beneficial to their Potential Career (N = 76)

Scale	f	Percent
Strongly Agree	28	36.8
Agree	33	43.4
Neutral	10	13.2
Disagree	5	6.6
Strongly Disagree	0	0.0

Based upon student responses on the final evaluation, the majority of the participants found the plant breeding module to their liking (51.8%) with a mean of 2.17, liked much, and only 15.1% did not like the plant breeding module (Table 4). In general, the majority of the students understood the general concepts of plant breeding with 80.5% of the students responding that they believed they had a better understanding of plant breeding following the module (Table 5). Students also responded that they found the directions easy to navigate (84.2%) and the module useful to their learning (75.9%).

Table 4. Plant Breeding Final Evaluation Question (N = 133)

How well did you like the Plant Breeding Module?	Percentage
Liked Very Little	4.3
Liked Little	10.8
Neutral	31.7
Liked Much	28.1
Liked Very Much	23.7
Mean	2.17

Note. Score: 1 = Liked Very Much, 2 = Liked Much, 3 = Neutral, 4 = Liked Little, 5 = Liked Very Little

Table 5. Plant Breeding Opinion Question Responses Post-Test (N = 133)

Question	Percentage
Do you believe that you have a better understanding of plant breeding after this module?	
Yes	80.5
No	5.3
Did you find the directions easy to navigate?	
Yes	84.2
No	3.1
Overall, did you find this activity useful in your learning?	
Yes	75.9
No	9.8

R3) What were the students' perceived learning experiences using the plant breeding module?

Following the post-test, we wanted to obtain the opinion of the students about their experience with this instrument. Eighty-eight percent of the students felt that this module was useful based upon qualitative responses and had a positive comment to report, falling into one of three categories: learned about plant breeding, different form of learning/hands-on and easy to follow and understand (Table 6). While only 11.8% of the students said that they did not find the module useful either because it was too simplistic for the age group or because they were frustrated with the technology. Some of the reasons for the usefulness of the module that the students provided were the following: Student 1["Learned basics of plant breeding"], Student 2["the activity is different to the usual class exercise, the exercise makes it easy to remember"], and Student 3["the activity created a visual aid of the process of pollination"] (Table 6).

Overall, the students demonstrated an interest in understanding the plant breeding concepts and in its potential ability to help with a potential career. Regrettably, after the introduction of the module, the participants showed a lack of improvement in their test scores. On the other hand, most of the students indicated that the module helped them to understand the technical practices of plant breeding in the field.

Summary

In general, students reported that they could successfully navigate the module and categorized it as good to introduce knowledge on plant breeding. Although, the scores decreased slightly on the post-test students still felt that the module was valuable for

Table 6. Themes Regarding Students' Perceived Usefulness of the Plant Breeding Module

Theme	Frequency (N=101)	Example Quotations
Yes		
Learned about plant breeding	51.5% (n = 52)	(P1) "I learned some basics of plant breeding." (P2) "It taught me how plant breeding is done." (P3) "Learned basics of plant breeding." (P4) "Made me have a general idea of plant pollination, awesome." (P5) "I learned a lot more about breeding and the steps to do it." (P6) "Taught me the techniques used in plant breeding." (P7) "I now know the techniques different farmers use to pollinate crops." (P8) "The activity is different to the usual class exercise, the exercise makes it easy to remember."
Different form of learning (ex: Hands-on)	22.8% (n=23)	(P9) "Different type of learning." (P10) "It was hands on." (P11) "Because it was easy to follow and hands on." (P12) "It's about as hands-on as it can be for the season."
Easy to follow and understand	13.9% (n = 14)	(P13) "Step by step processes were helpful." (P14) "The video gave me a step by step walk through of the process (which was great)." (P15) "Was very informational and easy to follow and understand." (P16) "It was very simple to follow and understand." (P17) "It explained step by step how to cross plants."
No		
It was too simplistic for our age.	5.9% (n = 6)	(P18) "Very elementary." (P19) "It seemed not geared towards college students."
Frustrated with the technology	5.9% (n = 6)	(P20) "The inability to go back or stop the movie was frustrating." (P21) "You are unable to navigate video. It also plays voice if you exit and it is playing and you must exit iFarm to restart." (P22) "iFarm quit working so I couldn't even finish the worksheet, when I went back later it finally worked."

their future. Students at all schools could benefit from STEM education which could lend to more real-world experiences that enhance their basic abilities to develop or enhance their decision making and critical thinking skills. By developing a tool that brings this experience to the classroom, students potentially learn about plant breeding. This was observed on the significant tests based on the one-paired t-tests analysis. Plant science education needs to encompass online resources that are available to integrate real world situations as described within this paper. In this study, we had the opportunity to evaluate the impact of this module on college students

as a method to inspire them to pursue a graduate school degree in plant breeding. Further work would involve visualizing the importance and need of professionals within the field of plant science. We would like to also modify and introduce this module to K-12 students as a method to introduce plant breeding careers as an alternative option for those student interested in science.

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Using Reusable Learning Objects (RLOs) to Share International Experiences: Faculty Perceptions and Best Practices in a College of Agriculture¹



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Abstract

Educators across colleges of agriculture continue to strive to improve the educational experience for students. The use of reusable learning objects (RLOs) is one method that is being pursued. For the purpose of this study, an RLO was defined as a short (i.e., 5-15 minutes), media-based instructional package that included a learning objective, content, media (pictures, videos, and/or audio) and an assessment. This study was grounded by Kolb's theory of experiential learning in the collection of prelection and reflection responses from participants and the area of instructional design in regard to the development of reusable learning objects. The purpose was to investigate faculty perceptions of RLOs and by doing so, document challenges to creating RLOs and determine best practices for development and use in order to internationalize agricultural curriculum. Qualitative research consisting of face-to-face, semi-structured pre- and post-interviews was employed. Respondents reported positive perceptions of RLOs both prior to and after their engagement in the development process. This study revealed recommendations for practice that can encourage the development and use of reusable learning objects within colleges of agriculture.

Introduction

Educators across colleges of agriculture continue to strive to improve the educational experience for students. The sharing of international experiences by faculty with students is one example of how education can be improved. The use of reusable learning objects is one method among others, such as students' oral verbal-

ization (Pate and Miller, 2011), inquiry-based instruction (Thoron et al., 2011), experiential learning (Wulff-Risner and Stewart, 1997), "popular culture media" such as music and movies (Bruce and Ewing, 2009, p. 8) and virtual simulation (Rhoades et al., 2009), that is being pursued to improve education. RLOs are commonly defined and identified in a variety of ways. The IEEE (Institute of Electrical and Electronics Engineers, Inc.) broadly defined a learning object as anything that could be used for education (2002). A more specific definition stated that learning objects are "generally understood to be digital and multimedia-based, which can be reused and – in some cases – combined with other learning objects to form larger pieces of instruction" (Farha, 2009, p. 2). Each learning object should be specific to one topic (Boyle, 2003). Some authors have indicated that RLOs are small, only large enough to include, at the most, a few related ideas (Conlan et al., 2002; Polsani, 2003). One author indicated that length can vary (Downes, 2001) based on how many ideas were covered and how complex each idea was, however they should be independent of other related content (Boyle, 2003).

Researchers have articulated that an RLO is an object that can come in all shapes and forms (Downes, 2001; Farha, 2009; Muzio et al., 2002; Polsani, 2003). Therefore, there is some ambiguity involved when defining an RLO because of the vast differences in characteristics (Polsani, 2003; Sicilia and Lytras, 2002). For the purpose of this study, an RLO was defined as a short (i.e., 5-15 minutes), media-based instructional package that included a learning objective, content, media (pictures, videos, and/or audio) and an assessment.

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Benefits of Reusable Learning Objects

Being proficient in information and communication technology is incredibly important for students enrolled in a college of agriculture, both in class and after graduation (Cox et al., 2011). Internet use in colleges of agriculture has greatly benefited both instructors and students by facilitating communication between the two groups, allowing access to a greater range of resources for supplementing lectures and helping make the use of new technologies possible. However, colleges and faculty should keep in mind that Internet resources should be carefully examined for quality (Molnar and Fields, 2004; Rhoades et al., 2008). According to results from a Student Assessment of Learning Gains survey, students who were taught with an online lesson rather than in a traditional setting were more satisfied than the traditional group, showing that incorporating online elements into introductory soil science classes can effectively “enhance student interest, motivation and satisfaction” (Mamo et al., 2004, p. 51).

The possible benefits of using RLOs in the classroom are diverse and could have far-reaching impacts for faculty. A 2009 study by Farha found that test scores for students using learning objects were “nearly three times higher” (p. 8) than for traditional students who used texts. In addition, usage can decrease time and costs for faculty, as they have the ability to create lessons from units of already-developed material rather than assemble a lesson from scratch (Brusilovsky, 2004; Downes, 2001; Sicilia and Lytras, 2002). Using RLOs, especially within the context of online learning, helps students learn in a “spiraling, progressive manner” (p. 315) which is a mode of learning that comes naturally to the brain and promotes deep learning (Hamid, 2002). Students who used audio podcasts to gain knowledge about history and design of English gardens and horticulture scored the same as non-users on written exams and performed better than nonusers on oral exams that required students to gain a deeper, more interlinked understanding of the material (Siciliano et al., 2011). Using technology in courses benefits students by giving them experience with technology that they can apply to future situations. Additionally, technology can be used very successfully to teach agribusiness components such as marketing, finance and management to agribusiness students (Schurle et al., 2004).

While educators have historically been required to do at least some re-authoring of material in order to mold it to the needs of their current students, RLOs allow educators to easily reuse material by breaking it up into small chunks. Because the lessons based on RLOs could be “personalized to a learner’s cognitive preferences,” the RLOs can result in “more effective learning”

(Conlan et al., 2002, p. 1). “[RLOs] most significant promise is to increase and improve the effectiveness of learning and human performance” (Hodgins, 2002, p. 76). According to this author, the major benefit of RLOs is the “ability to capture knowledge” (p. 79) so that it can be reused and eventually be improved with new information. The power of reusable learning objects is realized “when just-right information is flowing to the right place, person and time” (p. 79).

Drawbacks with Using Reusable Learning Objects

Given the benefits that exist, one might wonder why RLO use for agriculture and other fields has not been adopted on a more wide-scale basis. Sharing RLOs can be difficult due to their individual nature. Thus, what is a primary benefit becomes a drawback. As shared by Duval (2001), it can be extremely difficult to share metadata between users due to the use of many unique systems for managing metadata. This ultimately means that potential users of RLOs may find locating usable RLOs difficult, thus, there is a need to make finding them easier. Given that RLOs can be created on different programs and stored in different ways, the reuse of an RLO created by another individual is made difficult (Brusilovsky, 2004). Duval (2001) stated the importance of uniformity and consistency in the field of education and training.

The basic step of defining RLOs can also create dilemmas that affect overall creation and use. Muzio et al. (2002) shared drawbacks that could be associated with the use of RLOs that included size (i.e., How much information should it cover?) and the issue of “intellectual property” (p. 24). Related to this is the question of what is the best way to compile or classify RLOs (Churchill, 2007; Downes, 2001; Hodgins, 2002; Lukasiak, et al., 2005). Developers have concerns that their RLO will be used without citation and wonder whether or not they should be freely shared (Downes, 2001; Muzio et al., 2002). Finally, the ideal length of a learning object is a subject that has been contested for years (Churchill, 2007; Conlan et al., 2002; Muzio et al., 2002; Sicilia and Lytras, 2002).

Hamid (2002) listed three elements, “information architecture,” “user interface design” and “content strategy” (p. 313) as aspects that users and designers should be aware of when creating online learning content. Lack of awareness and understanding of these three areas could create drawbacks. Only limited research has been conducted about faculty perceptions of RLOs.

The purpose of this study was to investigate agricultural faculty perceptions of RLOs in order to better understand the creation process and use of RLOs

to internationalize the undergraduate curricula. A specific goal of the study was to document the following: 1) perspectives of the definition of an RLO, 2) challenges of creating and using RLOs, 3) benefits of creating and using RLOs, 4) best practices for development and 5) best practices for use.

Context of the Study

This study was part of a USDA Higher Education Challenge Grant that was awarded to faculty at the University of Florida, Texas A&M University and the University of Georgia. One goal of the grant was to utilize the development of RLOs by agricultural faculty to internationalize agricultural undergraduate curricula. An examination of participating faculty's perceptions of RLOs and the RLO development process both before and after their participation in an international experience and engagement in the RLO development process allowed a deeper understanding of how faculty see RLO use and application. This insight allowed the documentation of best practices that can benefit others seeking to utilize RLOs as part of their instructional process.

International experiences assist individuals in preparation for interdisciplinary work, according to a literature review conducted by Vincenti (2001), because they practice putting their material into different cultural formats during their time abroad. This study sought to determine agricultural faculty perceptions and reactions to RLO development in the context of using content collected in an international setting.

The need for instruction to be increasingly efficient and effective across the field of agriculture is critical. This study sought to add to the body of knowledge related to teaching and learning by focusing on the use of reusable learning objects to internationalize agricultural curriculum.

Conceptual Framework

The overarching framework for this study was based upon instructional design and the need for functional units of instruction. As stated by Love (1964), "successful teachers know that a unit of instruction must center on the needs of the student" (p.20). Students have become more technologically savvy and thus, there is a need for instructors to alter their perspectives of what instruction can be. There are a variety of ways in which instruction can be improved. Using technology that adds "animation, video and sound" to instruction provides students with a more interactive model that simplifies difficult concepts (Boyd and Murphrey, 2002, p.37). Gagne (1985) outlined nine steps that have guided the creation of quality instruction. These concepts include gaining attention, providing objectives, encouraging

recall, the presentation of material, providing guidance and feedback while also encouraging/assessing performance and enhancing retention. While it is true that reusable learning objects do not necessarily address all of the steps explicitly, these steps provide a good guide for the creation of quality content that can meet the needs of today's students.

Methods

Phenomenological research (Merriam, 2009) was used for this study. The methodological framework utilized Kolb's theory of experiential learning in the collection of prelection and reflection responses from participants. The study was deemed exempt by the Texas A&M University Institutional Review Board.

Kolb's theory of experiential learning (Kolb, 1984) and, as an extension of Kolb's model, the addition of prelection (Jones and Bjelland, 2004) provided a mechanism to collect rich data from participants. Kolb outlined four stages of learning: abstract conceptualization, active experimentation, concrete experience and reflective observation. As individuals are guided through each of these stages, an awareness and understanding of the topic at hand is gained. Jones and Bjelland (2004) introduced the idea of prelection. Prelection is a means by which participants are made aware of the expectations of the experience to be had. This activity promotes participants' learning during the first three stages of Kolb's theory of experiential learning model and, in turn, promotes a higher level of information processing during the reflection observation stage.

Participants were purposefully selected. According to Merriam (2009), criterion-based selections, or purposive samples, are selected based on identified, desirable characteristics. The participants were chosen based on their participation in the Trinidad and Tobago Faculty Abroad experience. There were a total of eight faculty members who participated in the international experience and thus were selected for participation. Participants were described as including both male and female faculty members with extensive teaching experience and adequate use of technology.

Each participant was engaged in a face-to-face, semi-structured pre- and post-interview process (Merriam, 2009). The protocol contained open-ended questions about the objectives of RLOs and the creation process. The exact wording and order of the items were not predetermined; rather, they served as guiding questions for the researchers to explore identified topics and issues. Examples of questions included: What is your personal definition of an RLO?; How difficult do you feel creating an RLO will be?; How do you expect to incorporate the RLOs you create into your classes?; and,

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What impact do you think your RLOs could have on your undergraduate curricula? Time was allowed for the participants to communicate any additional information and/or comments to the researchers. The same protocol was used for both the pre- and post-interviews. However, it was reworded for the post-interview to encourage reflection on the experience and allow the researchers to identify any changes or impacts of the experience on the participants. The participants were coded (using the designations R2 through R9 to identify participant responses) to ensure confidentiality.

Each interview, both pre- and post-, lasted approximately 30-40 minutes. The interviews were held in a location chosen by the participant so they would feel comfortable. Two researchers were present at each interview and took field notes to record the participant's responses. After the interviews were completed, the researchers compared and compiled field notes in a debriefing session to ensure the understanding and accuracy of the recorded responses; the data were then compiled into one document. Follow-up interviews were conducted as needed to further understand the best practices associated with RLO development and use. Participants were contacted by telephone, email, or in-person for the follow-up interviews.

The establishment of trustworthiness (Lincoln and Guba, 1985) is critical within qualitative research and is dependent on ensuring credibility, transferability, dependability and confirmability. Credibility was established through persistent observation, referential adequacy and peer debriefing by the researchers (Erlandson et al., 1993). Purposive sampling and the use of participant quotes enabled transferability, while the use of a reflexive journal and audit trail ensured dependability and confirmability (Erlandson et al., 1993). In addition to the in-depth, pre- and post- interviews, one of the researchers accompanied the faculty participants during the international experience and recorded field notes in regard to the RLO development process, thus allowing persistent observation.

The data were analyzed using the constant comparative method as described by Glaser and Strauss (1967) in which each comment or statement is compared against one another to determine categories and themes. This method of qualitative data analysis is comprised of four stages: (a) comparing incidents applicable to each category, (b) integrating categories and their properties, (c) delimiting the theory and (d) writing theory (Glaser and Strauss, 1967). The researchers unitized the data and categorized them into emergent themes. The themes were identified as perceived definitions of RLOs, challenges of RLO creation, benefits of RLO use and best practices.

Results and Discussion

Perspectives of the Definition of a Reusable Learning Object

During reflection, faculty participants articulated that a RLO is *"information that would accomplish one learning objective. It may consist of printed material, web, audio, video, various opportunities to engage the student in that learning objective"* (R8). RLOs package *"content, case studies, and assessments"* (R4) to address a topic. The responses are not surprising given that project planners had informed participants of RLO components during the initial faculty participant recruitment process. Participants also indicated that RLOs were easily transferable and usable by interested parties. Although only one of the faculty members had created RLOs in the past, the other seven faculty members indicated that they had created what they felt to be similar learning objects for their classes (e.g., case studies, annotated presentations, etc.).

In analyzing the reflection interview data, the experience affected the faculty's understanding of the RLO creation process and content requirements. Faculty gained an increased awareness of the student's perspective. *"The experience changed my idea of a RLO; it made more important the need to provide as rich a context as possible"* (R6). *"[A RLO] should be contextually rich. It takes students virtually to a place and gives them a vicarious experience"* (R8). Faculty participants also expanded their view/understanding of the content requirements. *"The PowerPoint is just the beginning. You have to write the assessment, write the key of the assessment, provide enough information [for those that want to use your RLO]"* (R3). *"The expectations are to include more videos/interviews than I thought"* (R4); RLO users need to be able *"to put their own context to it to make it applicable to larger systems"* (R8).

It can be concluded that for this group of faculty the idea of creating a small, reusable learning piece was not a new phenomenon, but rather the reintroduction of a process with a new name. During their reflection, faculty indicated that RLOs would be easily transferable and usable by others. However, as shared by Duval (2001), the sharing of material can be difficult. In fact, the literature clearly stated that the success of RLO use will depend on *"standardization"* (Duval, 2001) of RLO development. It is possible that the way in which the program was organized and administered influenced the perception of the participants and caused them to feel that the RLOs developed as part of the program would be easily shared as a result of support from program staff.

Challenges of Creating and Using Reusable Learning Objects

During pre-reflection, participants indicated that the RLO creation process would not be difficult, but it would be most challenged by lack of time to work on the materials. “[RLO creation] will not be difficult, especially in terms of innovative ideas; the time constraint will be difficult” (R7). The lack of a set template was also a challenge for faculty. “It will not be hard after I identify a form” (R4). “I suspect there will be a lot of agonizing over the first one; then you get a work flow pattern established” (R3). Faculty indicated that the work may be made more efficient by collaborating with another faculty member through teamwork (R8, R9).

During post-reflection, the faculty spoke about the challenge to RLO creators to provide ample and vivid context for both the teachers and students that may review the content (R3, R6, R8). “*The difficult part is creating the context. I feel the responsibility to create the context to make it hit home [with the students]*” (R6). In addition to providing acceptable context, challenges also included issues related to time and layout. Challenges expanded to include filtering through and gaining access to all of the media that was collected. “*The video I want, another faculty member has it; also, I don’t have access to all the pictures and video right now*” (R8). Writing the script for the narration was also seen as a challenge (R2). Contrary to the faculty’s initial pre-reflection to collaborate, not one RLO was created as a team effort.

A need exists for increased support to be provided in terms of training and technical support. The use of video was specifically identified as an area where assistance was needed. Further, engagement in the RLO development process caused faculty to be more individual in their approach rather than working as teams and a need exists to encourage teamwork and collaboration through project activities.

Benefits of Creating and Using Reusable Learning Objects

During pre-reflection, when asked about the potential impact of the RLOs on their curricula, faculty agreed that RLOs would not only extend the students’ understanding of the content, but would also provide the students with a broader perspective of the content (R2-R9). RLOs will allow students to “see how others do what we do in a different context” (R5) and “get students to think about broader, more varied context” (R6). Participants reported that RLOs would allow students to see an international setting and possibly correct their misconceptions of different cultures. “*There are misconceptions of different cultures; [students] see them as third world and tribal versus having cities, etc.*” (R7).

During post-reflection, the faculty expanded on the impact that the international experience and RLO development could have on their curricula. Faculty indicated that the RLOs would be welcomed by the students as a new teaching method. “*Students will value that it is something that I experienced and created, not just a video I found*” (R2). Faculty also responded that the RLOs would be much easier to present because they were a genuine experience. “*I feel more comfortable presenting the information to students because it is a genuine experience; it will feel more real to the students*” (R5). Respondent R8 indicated that RLOs are a new teaching method that could be incorporated into a teaching methods curriculum. Respondents also reported hope that the RLOs would increase the students’ awareness of opportunities abroad (R2, R4, R6, R7, R9). “*I hope, if we do a good job, it would elicit more of a study abroad interest for our students*” (R6) and an “*increased awareness of opportunities abroad, such as study, research, and careers*” (R9). The use of RLOs focused on sharing specific international experiences can not only provide students with an increased awareness of international opportunities, but will allow students to make global connections. “*[RLOs] will provide students a different perception of how policies can impact the U.S. and how they impact other countries*” (R7). As an extension, the faculty expressed hope that their RLOs can be used by other faculty in their own disciplines and in other disciplines to make both global and cross-discipline linkages. “*I see opportunities for the strengthening of relations between disciplines, such as agriculture, health and urban planning*” (R6).

Best Practices for Development of International Experience RLOs

Faculty provided reflections on best practices for RLO development. Faculty members made suggestions that affect every aspect of RLO creation, starting with the planning process. It was shared that the excitement and opportunities in the destination country can become overwhelming. Faculty suggested that RLO creators have a clear idea of the topic(s) that they want to address. “*The trip provides you with so many valuable opportunities, ideas, and contacts that you get overwhelmed in the process*” (R7); “*...losing focus becomes easy. Having a concrete topic beforehand helps you to remain centered on the information you are looking for to assist you in creating a high quality RLO*” (R9).

Every faculty member (R2-R9) indicated in the pre-reflection that teamwork may be a beneficial component to RLO creation; in the end, not one RLO was created as a team effort. In reflecting on the best practices of teamwork in RLO creation, faculty had varied opinions.

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“I work well by myself, but teamwork is always good to stimulate each other. I guess I would favor it, but small teams... not more than two people per team” (R2). *“I think utilization of teams would have been a good idea. This framework would have made participants accountable to other team members”* (R7).

There were also mixed opinions about the type of media inclusion that should be used in RLOs. *“I think video is more important because it includes audio and pictures”* (R9); *“I think [short videos] would be more effective [for student learning]”* (R2). *“I’m really glad I did the video segments, but I must admit, I spent an inordinate amount of time planning them, and they didn’t add as much as I thought they would”* (R3). *“Video with audio is best—but also most difficult. Audio over pictures is probably most realistic”* (R8).

The most resounding best practice was to work on and try to complete the RLOs while still in the destination country. *“Stick to the goal of having the RLO done BEFORE departing the country”* (R3), *“the problem is that once you got back to the U.S., other issues take precedence over the RLO”* (R7). *“I really do think the reflective work time in country is important”* (R3).

Another suggestion was the use of a trip theme for the RLO topics to address. *“Everyone would be writing toward the same learning outcomes...taking a team approach to developing a very targeted, comprehensive learning module; everyone contributes in the areas of their expertise”* (R3). *“This would allow for more utilization beyond case study focus”* (R7).

Best Practices for Using Reusable Learning Objects

Reflection indicated that RLOs may be best used as lesson enhancers versus primary lesson topics. One faculty member shared, *“The most effective use of an RLO is to enhance a current topic in a course...reflect on the information in the course and use the RLO to improve global understanding of the issue”* (R9). *“RLOs can be used best as interest approaches, as advanced organizers, as realistic problems. [They are] less valuable to teach specific content”* (R8).

Recommendations and Implications

This study revealed recommendations for practice that can assist the profession in encouraging the development and use of reusable learning objects. A clear definition and description of how RLOs will be used must be provided to participants involved in the process. Technical support should be provided that allows the faculty to focus on the content to be shared in each RLO. In addition, the use of metadata will be important as the RLOs are promoted for use by other faculty. While

participants reflected that the RLOs they developed would be useful to others, it is not known to what extent RLOs have been utilized. Further, professional development in regard to effective development strategies and the use of media is critical.

The focus of this study was limited to the perceptions of agricultural faculty involved in the development and use of RLOs related to an international experience. Additional quantitative research is needed that focuses on the adoption and use of the RLOs developed as part of this project. The engagement of a larger sample would allow for the testing of relationships between variables and more accurately measure the effectiveness of the use of RLOs. Questions still remain regarding the use of RLOs. For example, how many students were impacted as a result of the RLOs developed? How have the faculty involved selected to use the RLOs developed? How many faculty, outside of those who participated in the creation of the RLOs, have used the RLOs for instructional purposes? Addressing these questions can generate further data to support or dispute the use of RLOs in colleges of agriculture.

Summary

Reusable learning objects (RLOs) offer tremendous potential in regard to extending the reach of educators across colleges of agriculture to serve students in an efficient manner. However, it is recognized that challenges exist in regard to development and delivery. RLOs must be developed in a way that provides value to both instructors and ultimately to the students. The findings from this study revealed that faculty gained a stronger understanding of RLOs and their value through engagement in the process. Findings also revealed that while faculty may see value in the creation of RLOs to internationalize curricula, they recognize that the creation of RLOs can be time consuming and require technical skills for quality development. In addition, engagement in the process appeared to have changed the participants’ perception of the type of content that should be used and the way that context should be used in the creation of RLOs. Although faculty reported during reflection that collaboration and teamwork would be beneficial, results of post-reflection revealed that they did not engage in these activities in the actual development of their own RLOs. Post-reflections also revealed that faculty viewed the RLO development process as a means to bridge disciplines.

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Self-Efficacy as a Predictor of Academic Performance among Students in an Entry-Level Crop Science Course¹



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Abstract

While considerable research has examined the academic and cognitive value of assessments, little has been reported within the discipline of Crop Science and its impact of college students' performance. The purpose of this descriptive-correlational study was to assess the strength of self-efficacy of students taking an introductory crop science. Students in two academic settings (land-grant university and a community college, N=112) taking an entry-level agriculture course participated in an assessment and a diagnostic test, where self-efficacy was assessed in five agriculture subject areas (crops, soils, plant identification, technical applications/equipment, plant physiology) before and after the course. Results revealed a consistent predictor of academic performance was based on the diagnostic test. Although the mean scores were higher on the post-evaluation than on the pre-evaluation, self-efficacy was more consistently correlated with evaluation scores on the pre-assessment. This study presents a viable method for developing an evaluation tool to identify students that may require extra attention and course units, which may involve more class time or explanation.

Key Words: Self-efficacy and student perceptions, entry level agronomy, crop science, strength of self-efficacy

Introduction and Theoretical Framework

Self-efficacy is a construct that has been evaluated in numerous behavioral studies. Self-efficacy describes a person's perception of their ability to complete a given task (Bandura, 2003; Zimmerman, 2000). Self-efficacy is not to be confused with other similar constructs such as self-concepts studied by phenomenological theorist, McCombs (1989) where perceptions of more general constructs such as self-esteem are used as a measure of a person's perceived capacity to complete a task.

Perceived self-efficacy can be assessed based on level, generality and strength. Level, refers to the magnitude of difficulty of a given task (Zimmerman, 2000). Level of self-efficacy may be used to describe a subject's self-efficacy towards being able to run five miles compared to running one mile, for example. Generality refers to being able to transfer self-efficacy perceptions from one discipline or subject matter to another (Zimmerman, 2000). If for example, perceptions were generalizable between mathematics and statistics, then people with high self-efficacy regarding math would also have high self-efficacy beliefs with regards to statistics. Strength is the magnitude of how certain a subject is that they can perform a given task (Zimmerman, 2000).

The theoretical framework of this study relied on Bandura's (1977) self-efficacy theory. In the context of education and cognitive studies, measures of self-efficacy have been shown to accurately predict future academic

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performance (Bandura, 1993; Zimmerman, 2000). Not only does higher self-efficacy predict better academic performance in general, but also among individuals of similar skill levels, individuals with higher self-efficacy within groups of individuals with similar skill perform better (Collins, 1982). The utility of self-efficacy as a predictive tool has been shown to vary based on subject matter (e.g., English versus mathematics) (Zimmerman, 1995).

Similar subjective measures are also very common in agriculture education studies but differ significantly from other cognitive studies. Cano and Garton (1994) used the Group Embedded Figures Test (GEFT) in order to correlate agriculture education students' preferred learning style (field-dependent vs. field-independent) with both overall course scores and laboratory scores. Moss et al. (2002) used the Gregoric Style Delineator Profile to correlate agriculture economics students' learning style (Concrete Sequential, Concrete Random, Abstract Sequential, Abstract Random) with several components of course performance including; class discussion, exams, online coursework and overall course scores. These measures are subjective in that they are self-reported by study participants and cannot be confirmed by investigators.

Subjective measures in educational studies offer some customizability based on the nature of the course. For example, if a course has a laboratory component then investigators might collect subjective measures regarding student's preferred learning style such as: visual, hands on, field-based, etc. However many educational studies do not take specific areas of course material into account.

The Purpose of this Study

The purpose of this descriptive-correlational study was to assess the strength of self-efficacy of students taking an introductory crop science course at the beginning and end of the semester with regards to course material and competencies.

The research objectives of our study included:

1. To describe the general characteristics of the study population and determine if variations in evaluation scores were statistically significant among the groups.
2. To describe general trends of student perceptions both before and after the course and their performance on a diagnostic test.
3. To determine if the instrument used to assess student perceptions is reliable and evaluation scores are normally distributed.
4. To correlate student perceptions (self-efficacy measure) regarding their perceived notions of their knowledge relating to specific course subject matter

with scores on a diagnostic test (academic performance measure) and determine if the correlations are statistically significant.

Materials and Methods

Study Participants

This study focused on all students enrolled in an introductory crop production course within 4-year and 2-year institutions during the academic years of 2011-2012. The lead researcher has been involved as the lead supervisor for the articulation of the course content that is shared between the two institutions, in the agreement that articulation of content is as seamless as possible. This study was deemed a time and place sample (Oliver and Hinkle, 1982), thus permitting the use of inferential statistics. This study was deemed exempt by Purdue University-West Lafayette (WL) Institutional Review Board representing both populations of this study.

Evaluations were administered to students at Purdue-WL (a 4-year program) as well as Ivy Tech Lafayette (a 2-year program). Ivy Tech Lafayette instructors are attempting to replicate course material and competencies of Purdue-WL's course. Most participants were male (N=90, 79.6%), which is much higher than the proportion of male students enrolled at either Purdue-WL (57.4%) (Enrollment Analysis and Reporting, 2011) or Ivy Tech (40%) (Eric Burns and Tim Escue, 2011). However this is not unexpected as one might assume that there would be a greater proportion of males in agronomy courses. At the point of the initial assessment the majority of participants attended Purdue-WL (75%), grew up on a farm (63%) and were classified as freshmen (49%) (Table 1). Although at the beginning of the Fall 2011 semester at Purdue-WL the enrollment of Freshmen was only 27%, the high proportion of Freshmen in this course is not unexpected as it is an entry level course. The lower N-values for the post-assessment across all demographics were due to loss to follow-up at the end of the semester (Table 1).

Evaluation Protocol

Investigators administered evaluations during the first week of classes and after the completion of the course. Purdue-WL students were given a small extra credit bonus for filling out each evaluation accounting for less than 1% of their final course grade. Ivy Tech Lafayette students were not offered any incentive to participate. It is important to note that investigators administered performance evaluations immediately after self-efficacy assessments. Self-efficacy has been a significant tool in predicting future academic performance (Zimmerman, 2000; Bandura, 1993), however it has also been shown to be a viable predictor of academic per-

formance even when the evaluation component immediately follows the perception assessment (Collins, 1982).

Self-Efficacy Assessment

Strength of self-efficacy was assessed using a 39-item assessment tool developed by the lead investigator. Participants responded using a five point Likert scale; strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1. Respondents also were given a no opinion option. Items regarding general perceptions of the students learning style, as well as the student’s

perceptions of where this course fit into their career goals were summed together to form the “overall” scale. Items of related specific course subject matter were summed to the scale categories crops, plant identification, soils, photosynthesis processes/plant physiology and technical applications/crop science equipment. See Table 2 for distribution of perception items on the perception assessments. Investigators based scales on course goals outlined in the course syllabus (Snyder, 2012, <http://www.agry.purdue.edu/courses/agry105/>).

Investigators distributed the same assessment tool to participants both before and after the completion of the course to assess student perceptions of self-efficacy. Most items were phrased, “My current level of ability, knowledge about subject X.....” However any items that were phrased in the future perfect on the pre-assessment were changed to the past tense on the post-assessment. The full perception assessments are available at request by contacting the corresponding authors.

Academic Performance

Investigators evaluated academic performance using a 75 item multiple-choice diagnostic evaluation developed by the lead investigator and reviewed by Purdue University and Ivy Tech faculty whose content area is Agronomy. All questions were multiple choice items related to the five subject matter scales mentioned above. The full academic performance evaluations are available at request by contacting the corresponding authors.

Table 1: Mean pre and post-evaluation scores for participants in the Fall 2011 and Spring 2012 semesters

Demographic	N ^a		Mean Evaluation Score Percentage (SD)		P-value	
	Pre	Post	Pre	Post	Pre	Post
Campus					<0.002*	0.574
Purdue University-WL	81	78	64.8 (10.3)	77.8 (8.9)		
Ivy Tech Community College-Lafayette	27	21	55.0 (13.8)	75.9 (18.5)		
Total	108	99				
Homestead					0.070	.0375
Farm	68	64	62.5 (11.7)	76.2 (11.4)		
Rural-non farm	27	23	64.9 (11.1)	79.7 (7.2)		
Town/city	13	9	55.7 (13.7)	74.4 (19.1)		
Total	108	96				
Classification					0.019*	0.163
Freshman	54	45	60.1 (11.8)	74.9 (9.3)		
Sophomore	34	32	63.0 (11.6)	77.8 (13.8)		
Junior	10	11	61.9 (10.6)	78.9 (9.7)		
Senior	10	11	72.9 (11.4)	83.2 (12.9)		
Total	108	99				

^aThe number of students in the Pre and Post sampling periods was 112

* Independent Student’s t-test Significant at P ≤0.05 level (2-tail)

Table 2. Mean standardized pre and post-assessment perceptions results for students in the Fall 2011 and Spring 2012 semesters

	Mean		SD		N		Reliability ^a	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Overall^c	4.40	4.24	0.40	0.42	107	96	0.647	0.583
Crops^d	2.77	3.74	0.65	0.47	107	95	0.784	0.754
Identification^e	2.97	3.84	0.67	0.51	108	97	0.853	0.831
Soils^f	2.93	3.92	0.61	0.52	107	98	0.780	0.742
Photosynthesis/plant physiology^g	2.80	3.82	0.64	0.55	102	97	0.835	0.806
Technical^h	3.31	4.00	0.64	0.55	102	96	0.721	0.145 ^b

^aCronbach’s alpha coefficient for reliability-Max value = 1

^bIf item 11 removed the Cronbach’s alpha is .788

Note: strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1

^c items 3, 4, 6, 8, 9

^d items 12, 13, 15, 34, 35

^e items 16, 17, 18, 19, 20, 21, 22

^f items 10, 25, 26, 27, 28

^g items 14, 23, 24, 29, 30, 31, 39

^h items 11, 33, 36, 37, 38

Statistical Analysis

Investigators used SPSS Version 19.01 for all statistical analysis. The first study goal was to determine if there was a statistically significant difference in mean evaluation scores across demographics. Thus a series of independent sample Student’s t-tests were run to determine if there was a statistically significant difference in mean evaluation scores between participants by campus (Purdue-WL, Ivy Tech Lafayette), former homestead (farm, rural non-farm, town/city) and classification (freshman, sophomore, junior, senior).

Based on study goal 2) investigators standardized assessment perceptions by dividing the summation of scaled items by the total number of items in each

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scale. Cronbach's alpha coefficients were generated to satisfy study goal 3) and to determine if scaled items were reliably measured. Shapiro-Wilk tests were also run to assess if pre and post evaluation scores were normally distributed. Lastly, Pearson Product-Moment Correlations were run to assess correlations between perception scales and academic performance.

Results and Discussion

Scores on the post-evaluation were higher across all demographics than the pre-evaluation as would be expected because the same evaluation was given during both pre and post sampling events (Table 1). Evaluation scores did not differ significantly between students of different homesteads on either the pre or post-evaluations (Table 1). The pre-evaluation scores differed significantly based on campus (P -value = <0.002), with Purdue-WL scores being higher than Ivy Tech Lafayette scores (Table 1). Pre-evaluation scores also differed significantly based on student classification (P -value = 0.019) with seniors scoring highest (Table 1).

Note that not all scales are the summation of an equal number of assessment items. Within Table 2 are the displayed standardized mean perception values. Investigators standardized responses by summing together item responses for each scale and then dividing them by the number of items relating to that particular scale. If a participant responded either "no opinion" or did not respond to a particular item, then their responses were left out of analysis for that particular scale. The standardized mean perception value was higher for all scales on the post-assessment (Table 2). This is to be expected as it is reasonable to expect that students would feel they know more about course material after having taken the course.

Mean responses were highest for the overall perceptions scale on both the pre and post-assessments (Table 2). Among scales related to specific subject matter, technical perceptions were highest on both assessments and lowest was for crops perceptions on both assessments (Table 2). It is worth pointing out that mean values of overall perceptions is only 0.04 more on the post assessment, whereas the mean response for nearly all other scales increased by about 1. This may have been due to the fact that items scaled as overall were somewhat vague in nature and concerned perceptions of how useful this course would fit into their career goals. Items related to specific subject areas were less vague.

Cronbach's alpha (maximum value = 1) coefficients were generated to determine reliability for scaled items. Alpha values were typically higher for pre-assessment scales (Table 2). Nearly all scales were above 0.7, indicating very good reliability among scales (Table 2). The second and third lowest alpha values were for overall perceptions on the pre-assessment (0.647), indicating decent reliability and the alpha value for overall perceptions on the post-assessment (0.583) indicating questionable reliability (Table 2). The alpha value for technical perceptions on the post-assessment (0.145) indicates very little reliability; however, if item 11 were removed from the technical scale then the alpha value would be 0.788 (Table 2).

Investigators evaluated academic performance in two ways; overall score on the evaluation and number of correct responses on items related to particular scales (Table 3). Shapiro-Wilk tests indicated that pre-evaluation scores were normally distributed and post-evaluation scores were not (Table 3). Notice in Table 3 that the numbers of specific items related to each scale are not equally distributed. Not only were overall scores higher on the post-evaluation than the pre-evaluation (Table 3), but scores for individual subject areas were also higher on the post-evaluation (Table 3). Again this is not expected as it is reasonable to expect that students would know more about course content after taking the course.

Correlations

All variables (perception scales, evaluation scores, number of correct responses per category) were treated as continuous variables. Pearson Correlation Coefficients were used to correlate self-efficacy measures (perceptions), with academic performance (evaluation

Table 3. Pre and post-evaluation results

Categories	M		SD		Median		Range	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Evaluation Score	62.89	76.86 ^b	11.6	11.5	63.34	78.6	60	64
Crops (Max=14) ^c	9.78	11.4	2.1	2.2	10	12	9	9
Identification (Max=15) ^d	6.79	9.03	2.7	2.4	7	9	11	11
Soils (Max =17) ^e	9.17	12.31	2.8	2.4	9	13	13	13
Photosynthesis/ plant physiology (Max=8) ^f	4.81	6.18	1.5	1.4	5	7	7	8
Technical (Max=21) ^g	14.08	16.79	3.0	2.5	15	17	15	13

^aNormally distributed based on Shapiro-Wilk test for normality ($P > .05$)

^bNot normally distributed based on Shapiro-Wilk test for normality ($P \leq .05$)

^citems 1, 6, 19, 40, 41, 42, 51, 62, 63, 67, 68, 69, 70, 71

^ditems 2, 4, 9, 10, 11, 14, 15, 16, 18, 34, 36, 61, 73, 74, 75

^eitems 3, 8, 31, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58

^fitems 12, 13, 17, 19, 20, 30, 59, 65

^gitems 3, 7, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 35, 37, 38, 39, 43, 60, 64, 66, 72

Table 4. Pearson Correlation Coefficients between self-efficacy measurements and evaluation performance

Perceptions-Pre Assessment	Pre-evaluation Score	Pre-evaluation Results by Subject Area				
		Crops	Soils	Identification	Technical and Equipment	Photosynthesis-Plant Physiology
Overall						
Pearson Correlation	.005	.024	-.099	-.077	.033	.114
N	107	106	106	103	105	106
Crops						
Pearson Correlation	.246*	.304**				
N	107	106				
Soils						
Pearson Correlation	.338**		.256**			
N	107		106			
Identification						
Pearson Correlation	.292**			.287**		
N	108			104		
Technical & equipment						
Pearson Correlation	.229*				.278	
N	102				100	
Photosynthesis & plant physiology						
Pearson Correlation	.278**					-.031
N	102					101

Note: The number of students in the Pre and Post sampling periods was 112.

* Pearson Correlation Coefficient is significant at the P ≤ 0.05 level (2-tail)

** Pearson Correlation Coefficient is significant at the P ≤ 0.01 level (2-tail)

Table 5. Pearson Correlation Coefficients between self-efficacy measurements and evaluation performance

Perceptions	Post-evaluation Score	Post-evaluation Results by Subject Area				
		Crops	Soils	Identification	Technical and Equipment	Photosynthesis
Post-Overall						
Pearson Correlation	.08	.112	-.037	-.096	.103	.12
N	98	98	98	99	97	99
Post-Crops						
Pearson Correlation	.146	.264**				
N	97	97				
Post-Soils						
Pearson Correlation	.227*		.261**			
N	98		98			
Post-Identification						
Pearson Correlation	.192			.17		
N	97			96		
Post-Technical & equipment						
Pearson Correlation	.175				.222*	
N	96				96	
Post-Photosynthesis & plant physiology						
Pearson Correlation	.221*					.098
N	97					98

Note: The number of students in the Pre and Post sampling periods was 99.

* Pearson Correlation Coefficient is significant at the P ≤ 0.05 level (2-tail)

** Pearson Correlation Coefficient is significant at the P ≤ 0.01 level (2-tail)

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score, number correct on specific subject matter). Correlation Coefficients are shown for each relationship for the pre-evaluations (Table 4) and post-evaluations (Table 5). Effects of gender were not tested between variables as the number of female participants was too low for meaningful analysis. A Correlation Coefficient of 1.0 indicates perfect correlation, .70-.99 very high correlation, .50-.69 substantial correlation, .30-.49 moderate correlation, .10-.29 low correlation, and .01-.09 (Davis, 1971).

Pre-Evaluation

Correlations between all perceptions regarding specific subject matter and evaluation score were statistically significant (Table 4). The correlation between the more general overall perceptions and evaluation score was not statistically significant (Table 4). Correlations between specific subject matter perceptions and number of correct responses on specific subject matter were statistically significant for three of five subject areas (crops, identification, soils) (Table 4). Correlations between overall perceptions and results in specific subject areas were not statistically significant for any subject area (Table 4).

Post-Evaluation

Correlations between perceptions regarding specific subject matter and evaluation score were statistically significant in only two subject areas (soils, photosynthesis/physiology) and were not statistically significant between overall perceptions and evaluation score (Table 5). Correlations between specific subject matter perceptions and number of correct responses on specific subject matter were statistically significant for three of five subject areas (crops, soils, technical/equipment) (Table 5). Yet again correlations between overall perceptions and results in specific subject areas were not statistically significant for any subject area (Table 5).

This study shows a consistent relationship between strength of self-efficacy and academic performance. Self-efficacy measures not only correlated with overall evaluation scores but also with evaluation performance across specific subject areas (Table 4, Table 5). The relationship between self-efficacy and academic performance was much more consistent during the pre-evaluation (Table 4). General perceptions did not significantly correlate with any measures of performance as items scaled as overall were more general items related to self-perceptions and course utility. This study supports the notion that self-efficacy accurately predicts academic performance.

Past studies have shown that a stronger sense of self-efficacy results in better performance in academics. Self-efficacy has also been used in studies concerning career development, life-course trajectories and health behavior (Bandura, 1995). Possible explanations for the correlation between self-efficacy and academic performance in this study are that students with a stronger sense of self-efficacy may be more likely to perform better because they may be more motivated, expend more energy on academics and exhibit more persistence (Zimmerman, 1995). In a study regarding student effort in academics by Salomon (1984), it was found that students with higher self-efficacy are more likely to be high achievers in general and more likely to seek out extra-curricular activities as well as spend more time studying. Berry (1987) showed that students with high self-efficacy are more likely to be persistent and seek out opportunities outside of class such as extra help sessions in order to improve.

Self-efficacy has been used in few studies with agriculture students specifically. Johnson et al. (1999, 2000) performed two studies regarding agriculture students' self-efficacy with respect to computer proficiency. Both studies reported low scores in self-efficacy, but only one (Johnson et al., 1999) using participants in freshman level courses demonstrated that self-efficacy was a strong predictor of computer proficiency. The other study using participants in upper level agriculture courses (Johnson et al., 2000), found that there was only a weak association between self-efficacy and computer proficiency.

The relationship between self-efficacy and academic performance was far more consistent on the pre-evaluation than on the post-evaluation in this study. This pattern is not unexpected or outside the norm as self-efficacy has been shown to be a strong predictor of future academic performance (Zimmerman, 2000). In this study the academic performance evaluation was given immediately following the self-efficacy assessment. At the point of the pre-assessment students were asked to assess their knowledge/ability with regards to course subject areas, which they had not yet been exposed to in this particular course. On the post-evaluation the opposite was true, which may have influenced the relationship between self-efficacy and academic performance. Although measures of self-efficacy generally increased on the post-assessment and scores on the post-evaluation were higher, the relationship between self-efficacy and academic performance was not statistically significant across many subject areas on the post-evaluation. The less consistent pattern observed on the post-evaluation may be because evaluation scores were not distributed normally (Table 3).

Limitations, Conclusions and Recommendations

The study analysis was limited as correlations of pre-assessment perceptions and post-evaluation scores could have been used to express student learning gains over the semester to determine if pre-course perceptions could predict end of course knowledge. However correlations between pre-assessments and post-evaluations did not yield any useful data. This may have been due to the non-normal distribution of post-evaluation scores.

Not only were the scores on the post-evaluation generally higher among all students than their pre-evaluation scores, but their post-assessment perception scores were also generally higher. This trend is not unexpected and is actually desirable for course instructors as it shows that not only do students feel that they know course material better after having taken the course, but they actually know course subject matter better based on the results of their evaluation tests. However given this general increase in scores across most students, the results on the post evaluation were skewed towards a higher distribution and thus were not normally distributed. This limits the use of most tests of association on post-evaluating data which must assume normality.

This study demonstrates a feasible and effective method for instructors to assess their students perceptions of their own knowledge across course subject matter based on course goals and competencies. Using student perceptions as a measure of self-efficacy could allow instructors to identify not only students who may require extra attention but also to identify course units that may require more class time or explanation. By basing self-efficacy assessments on specific course units or competencies rather than on more general notions of learning style, which have been used in cognitive studies by Cano and Garton (1994) and Moss et al (2002), where instructors would be able to develop an assessment tool that is more applicable to their course specifically.

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The USDA Scholars Program: Innovations in a Summer Undergraduate Research Program¹



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Abstract

The USDA Scholars Program is an innovative summer undergraduate research program at Virginia Tech, funded by the United States Department of Agriculture (USDA), that integrates undergraduate research with peer mentoring, grantsmanship, a specialized summer course and a summer multi-institutional symposium. The results of a qualitative and quantitative assessment of the USDA Scholars Program, which consisted of 42 undergraduates over a 5-year period from 2007-2011, are presented. Students participating in the program were co-authors on eight peer-reviewed publications and three additional articles in preparation, as well as 17 posters at national and international scientific meetings. USDA Scholars self-assessed themselves with a 65-68% gain in perceived confidence in research ability and in one of the assessed years, a slight, but significant increase in perceived public speaking ability. Seventy-five percent of USDA Scholars continued research in the following academic year and the department hosting the program showed a significant increase in the total number of students (including non-Scholars) engaged in undergraduate research. Overall, the USDA Scholars Program can serve as a model for other departments interested in designing a comprehensive summer undergraduate research program.

Introduction

Since the publication of the Boyer Report (1998), a number of institutions have identified the value of undergraduate research in their educational objectives.

However, in the current climate of tenure and promotion, along with reduced federal funding, faculty struggle with the time and financial commitment required to support undergraduates in their laboratories, even though they fully understand the value of this type of active learning. The Council on Undergraduate Research (CUR) has identified several key learning outcomes of undergraduate students involved in an undergraduate research experience (NCUR, 2005). Undergraduate researchers gain specific skills in using literature, formulating hypotheses, interpreting data and communicating results. They also show measurable gains in reflection, independence and self-confidence, career clarification and career preparation. Undergraduate researchers obtain undergraduate and graduate degrees at a higher rate than comparison groups. As alumni, they report higher gains in skills such as carrying out research, acquiring information and speaking effectively (Karukstis, 2006, Kinkel and Henke, 2006, Levis-Fitzgerald et al., 2005, NCUR, 2005).

Undergraduates who are drawn to the Department of Human Nutrition, Foods and Exercise (HNFE) at Virginia Tech often have career goals requiring graduate and professional school studies, with most of the graduating seniors heading to either a dietetic internship, medical school, physical therapy clinical PhD (DPT) and science-based PhD programs, or other graduate schools. The HNFE major provides a strong foundation in both basic and applied sciences in the area of nutrition, exercise and obesity. However, as is true at many universities,

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most HNFE students are not exposed to undergraduate research and often do not possess an awareness of what a career in research entails. A formal undergraduate research program, called the USDA Scholars Program, was developed and funded by a United States Department of Agriculture (USDA) Higher Education Challenge Grant. This program provided structure and oversight to the selection, training and funding of students, allowing faculty time to truly mentor and train students in their research field. More specifically, faculty were freed from providing individual training on such topics as animal and human welfare, grantsmanship, library and scientific reading skills, scientific writing skills, poster preparation and oral presentation skills. In addition, students acted as peer mentors for a variety of HNFE classes, thereby transferring their knowledge to additional students within the HNFE department.

The USDA Scholars Program was designed for HNFE students at Virginia Tech, but the principals of the program are translatable to many agricultural and nutrition departments. Importantly, now two years after the formal USDA-funded program ended, we have been able to continue a scaled-back version of the program using university funds. Details of the USDA Scholars Program can be used as a guide to develop a similar program at another university.

Program Description and Methods

The USDA Scholars program was conceived of and designed as part of an application to the USDA Higher Education Challenge Grant program. The grant proposal was funded with an August 2007 start date. For the summer of 2007, students were funded as part of a Virginia Tech Provost Summer Session grant, and the program was run as a pilot version of the full USDA Scholars program. The grant from the USDA funded the 2008-2010 Scholars program. For the summers of 2011 and 2012, students were funded using institutional money and faculty grant money to support stipends and programmatic events. This project was deemed exempt by Virginia Tech Institutional Review Board (VT-IRB), and did not require further human subjects oversight.

Recruiting and Application Review Process

Students in their sophomore or junior year were invited to apply in the fall semester via announcements in HNFE sophomore and junior level classes and a mass email to HNFE undergraduates. The full application consisted of a current transcript, application form and one letter of recommendation from an HNFE faculty member submitted to a secure website. For the first year of the program, student applicants were required to have

a minimum 3.0 grade point average (out of 4.0) and to have completed both semesters of anatomy and physiology, one semester of organic chemistry and one semester of biochemistry to be eligible to apply for the program. These course requirements were dropped for the subsequent years, but the GPA requirement was retained. For the 2008 program application, the application form consisted of five questions, available from the authors, upon request.

Following the initial year of the program, the application was amended to additionally ask students to identify two HNFE faculty members and to describe why they were interested in each faculty's research and how that faculty's research program complimented the career goals of the student. The application was designed to provide the reviewers and program directors with a complete picture of the type of student who was applying and how they might fit into the overall goals of the program. In general, we were looking for students who thought creatively and were not afraid to fail, but understood how to turn failure into a learning experience. We were also looking for students who understood how research could be used to complement their career goals, whether they ultimately wanted to focus on a research-based career or not. The redesign of questions in 2009 helped us to better match students with faculty mentors, by allowing students to choose research programs they were interested in and conversely having faculty read the applications and determine if they were interested in being matched with the student.

A faculty committee was recruited each year to review applications and using a rubric (available from the authors upon request), determined the finalists (up to 10, depending on program year) and two alternates. Students were matched with faculty and faculty conducted an in-person interview to determine if they would accept the student to their research/laboratory program. Finalists were notified of their faculty match and were given at least two weeks to accept and sign a formal contract. In some instances, students chose not to accept and the alternates were then matched with faculty mentors and notified of their acceptance to the program. Finalists were then given at least two weeks to accept and sign the formal contact. All slots in the program were filled using either the finalists or alternates.

Summer Research Program

Students who were accepted into the program were required to meet with their faculty mentor during the spring semester prior to the summer program and were expected to complete required training (Institutional Review Board, (IRB) Institutional Animal Care Program (IACUC) and/or laboratory safety training).

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They were also expected to write a one-page proposal for their research, including an annotated bibliography with papers relevant to their research. A 1-credit hour independent study for the spring semester recognized the students' work.

The summer program consisted of an expected 30-hour research work week, a 2 hour per week course and a 1 hour per week journal club meeting. At Virginia Tech, the summer is divided into two sessions (named summer I and summer II). The students were enrolled in 3 credit hours during the both summer semesters and were given a syllabus with required assignments and weekly course topics (available from the authors, upon request). During week 1 of the summer program, students went through "Boot Camp" which consisted of daily 1-2 hour group meetings and lectures going over library databases, using bibliographic software, personality assessment and intro to grant writing and budgets. During the rest of the summer, topics such as Research Ethics and Bench-to-Bedside Research (both panel discussions), resume building, oral presentations/seminars and writing workshops were provided.

In addition to the class, students met weekly for a research/journal club meeting. For this part of the program, the ~10 students were divided into three groups, each led by one to two graduate students and/or postdoctoral fellows. A journal article was selected at least one week in advance of the meeting and students came prepared to discuss the findings and implications. Each student had the opportunity to pick a journal article and to lead the discussion during the summer. This part of the program was developed to provide students with weekly practice reading and discussing journal articles and to ensure that all students were exposed to basic, clinical and community-based research articles.

Scholars were expected to give an oral presentation to the class at the end of the summer. For the USDA Scholars, the entire program culminated with The USDA Scholars Symposium—a multi-institutional symposium between Virginia Tech, University of Pennsylvania and Penn State undergraduate summer research programs. USDA Scholars were responsible for oversight and organization of the symposium program, registration and day-of-event tasks for 2008 and 2010 when the symposium was held at Virginia Tech. University of Pennsylvania students were responsible for organizing the symposium in 2009 when it was held in Philadelphia. For each year that the symposium was held, students gave oral and poster presentations and had social events with the undergraduates and faculty from the other institutions. Funds for the multi-institutional symposium were provided through the USDA Higher Education Challenge grant.

Following the completion of the summer program, students returned in the fall semester to serve as peer mentors in HNFE undergraduate courses and for individual freshmen. The tasks of the peer mentors varied with the courses they were assigned. For example, in some cases, Scholars were asked to give an oral presentation in the course and provide tutoring on PowerPoint presentation preparation. In other cases, Scholars met with an HNFE freshman to serve as an upper-classman mentor, guiding them on coursework and extracurricular activities. In still other peer mentoring situations, Scholars served as journal club leaders for the HNFE undergraduate journal club, a 1-credit course available to all HNFE students.

Tracking and Assessment of Program

Pre- and post-survey questions were collected prior to the start of the program and following the last week of the program, respectively. In a formative assessment, faculty mentors in the program were asked to evaluate their Scholar in the middle of the summer. A summative assessment at the end of the summer allowed faculty to evaluate the overall program and their individual Scholar at the end of the program.

For assessment by the Scholars during the program, Scholars were asked to write a weekly "Friday Reflections" on our secure course website. To do this, the program directors would prompt the discussion with a statement or question and Scholars were asked to comment on the prompt or on a response from another Scholar by the following Monday. Reflection statements from 2009 and 2010 Scholars program were captured in a Word document at the end of the semester. The Friday Reflection blog and the pre-, post- survey data from 2008 were lost due to a change from Blackboard (www.blackboard.com), to Scholar online course management system (Scholar is Virginia Tech's brand for the Sakai open source software), prior to when we downloaded the data. As there was no course for 2007, 2011 and 2012, so that no Friday reflections, or pre-post survey data were captured for these years.

Results and Discussion

Impact and Outcomes for Scholars

A total of 42 students were part of the Scholars program during the summer sessions from 2007-2011. Seven students are part of the 2012 Scholars program. Because of the interdisciplinary nature of the HNFE Department's research, the Scholar's research projects varied widely. Some Scholars were involved in basic research projects involving cellular and molecular biology (Figure 1A). Others had human subjects projects related to nutrition or exercise (Figure 1B), or social/behavioral studies within local communities (Figure

Figure 1: Research and Teamwork in the USDA Scholars Program at Virginia Tech. (A.) A USDA Scholar performing basic research (B.) A USDA Scholar working with a participant in an exercise research program (C.) A USDA Scholar performing community research (D.) USDA Scholars on a teamwork building extracurricular activity.



IC). Group outings, potluck parties, trips to other local events were encouraged (Figure 1D).

Students who participated in the program had a high rate of graduate school and internship acceptance, compared to all HNFE seniors. For those that were USDA Scholars between 2007-2011, one Scholar has obtained a Ph.D., one Scholar a clinical doctorate and two Scholars have obtained their MS in Human Nutrition, Foods and Exercise. A total of 15 students are currently enrolled in graduate school, either MS, PhD, DO (doctor of osteopathic medicine) or MD degree programs. Fifteen additional students are either completing dietetic internships, or working in their chosen field. Thus,

33 out of 42 Scholars (78%) went on to graduate school or professional internships following completion of the USDA Scholars Program. These data are in comparison to 51% of HNFE seniors who report graduate school and internship plans (2012 graduation survey, Renee Selberg-Eaton, personal communication)

Of the 42 Scholars who participated in the summer research program, 74% of them continued working in their research laboratories the following semester (Table 1). Five Scholars have a total of eight peer-reviewed publications as a result of their undergraduate research or continuing work in the same lab with a combined BS/MS or PhD degree, while 12 Scholars have presented their research at local or national scientific meetings.

Departmental Impact of USDA Scholars Program:

The impact of the Scholars undergraduate research program reached far beyond those individual students that directly participated. We found that research participation by all HNFE undergraduates for the fall semester following the summer program increased from only eight in 2007, before the initiation of the internally-funded HNFE Scholars program, to an average of 18, double the numbers prior to the Scholars program (Figure 2). With only 15 research-active faculty in the HNFE department during the measured time period, this most likely represents a near maximum number

of students that might be accepted to participate in undergraduate research for any semester. It is not clear to us why there was a dip in undergraduate research (both honors and regular) in the semester following the summer program. However, we do believe that overall, the USDA/HNFE Scholars program has created a “culture of undergraduate research” within the HNFE Department, as anecdotally, more students are seeking undergraduate research opportunities within the HNFE Department and across the university.

Peer-mentoring was a required (2008-2010) or optional but encouraged (2007, 2011) component of the program and peer mentoring increased the overall impact of the Scholars on HNFE undergraduates. Since

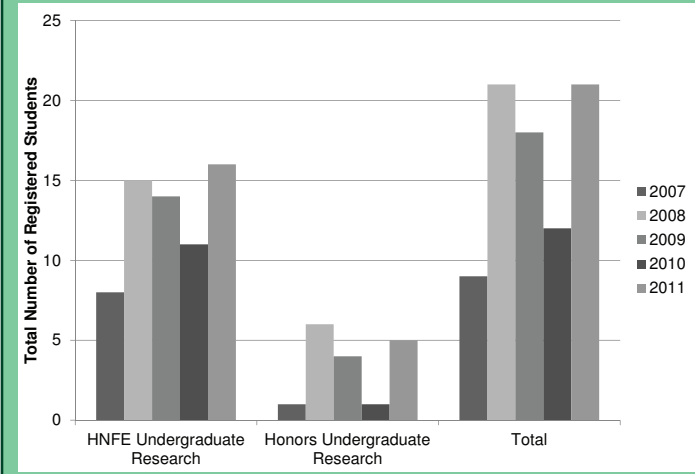
Table 1: Summary of USDA Scholars Program

YEAR	TOTAL NUMBER OF SCHOLARS	TOTAL CONTINUING RESEARCH (FOLLOWING SEMESTER)	SYMPOSIUM LOCATION	PEER REVIEWED PUBLICATIONS/POSTER PRESENTATIONS AT NATIONAL MEETINGS
2007	5	4	Virginia Tech	2 peer reviewed articles; 3 articles in preparation; 1 poster at national meeting
2008	7	6	Virginia Tech	4 peer reviewed articles; 6 posters at national meetings
2009	10	8	University of Pennsylvania	2 presentations at local meetings
2010	10	8	Virginia Tech	2 peer-reviewed publications; 6 presentations at local and national meetings
2011	10	5	Virginia Tech	2 presentations at local and national meetings
2012	7	N.A.*	Virginia Tech	N.A.

*N.A. = not available

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Figure 2: Total number of students registered for regular and honors-level undergraduate research in the department of Human Nutrition, Foods, and Exercise (HNFE) in the fall semester following the summer undergraduate research program at Virginia Tech (2007-2011). Following the official start of the USDA Scholars program, there was a 1.8-fold increase in regular undergraduate research enrollment and a 6-fold increase in honors undergraduate research enrollment for all remaining years, except 2010.



the start of the USDA Scholars Program on the Virginia Tech campus, 874 registered students in 15 different HNFE classes have received peer mentoring from the 25 undergraduates participating in the 2008-2010 USDA Scholars program, which had a required peer-mentoring component for the academic semester following the summer program. The Scholars also participated in freshman orientation and some individual scholars led undergraduate journal clubs (1 credit courses, open to all levels of HNFE students) for a total of 22 students. This

new class allowed USDA Scholars to share their skills in reading, interpreting and discussing research articles with fellow undergraduates and significantly increased the number of HNFE students involved in inquiry-based learning in a non-laboratory environment. According to other reports, journal clubs enhance critical thinking skills in undergraduates (Minerick, 2011; Roberts, 2009).

Multi-Institutional Impact of the Scholars Program

As part of the summer USDA Scholars program, three multi-institutional symposiums were held in August 2008-2010 at Virginia Tech (2008, 2010, and 2011) and the University of Pennsylvania (2009) (Table 1). Approximately 150 registered participants from Virginia Tech and the University

of Pennsylvania participated over the three years of the conference. Participants also came from other universities, including Penn State, the University of Michigan, Muhlenberg College and Davidson College. Undergraduate research was highlighted during these symposia with undergraduates giving oral presentations and presenting posters during the symposium (Figure 3).

Qualitative and Quantitative Assessment of the Program

The Friday reflections blog allowed faculty directors of the USDA Scholars Program, a forum for posing questions based on the week's activities (usually from the course) and students to provide individual reflections and responses to peer's reflections. All of the remarks are qualitative in nature. During the first week of Friday Reflections for 2009 and 2010 Scholars wrote that they were "blown away from the get-go" by their expectations of the program, which they also described as "pretty enlightening" and "overwhelming at times." Students also commented that they were nervous, but that "the boot camp idea works well and make (sic) the orientation much more enjoyable."

Student's comfort and confidence with independently performing research were assessed in this blog format, as well as in the pre- and post-surveys. In the blog, some comments related to their research include "I came into this program completely intimidated by the

Figure 3: Images from the USDA Scholars Multi-Institutional Symposium. (A.) Student participants for the first USDA Scholars Multi-Institutional Symposium. (B.) A 2008 USDA Scholar presents her poster to an HNFE faculty member (C.) Marquee advertisement at the University of Pennsylvania for the 2nd Annual USDA Scholars Multi-Institutional Symposium (D.) Students from Virginia Tech and the University of Pennsylvania pose in front of the Philadelphia Museum of Arts.



Ph.D. candidates and Master's (sic) students working in the labs because I was under the impression that their experiments always worked out perfect (sic) the first time. Obviously my assumption was wrong. Research is much more of a trial and error process than I expected." Another comment related to research was *"When I first began this program I thought research involved projects that were extensively planned beforehand and the protocol was strict, never changing. After a few weeks in the lab, I've learned that no protocol is for certain and things are always changing!"* Yet another student commented, *"I'm not used to engaging my brain so much. I'm used to memorizing, memorizing and more memorizing—that's what I'm best at. But for this program...I've had to read complex material, analyze, come to conclusions, have an opinion, etc."*

The pre- and post-survey assessment on confidence in research yielded quantifiable data that was statistically significant between pre- and post-survey results for both 2009 and 2010 analyses. Specifically, students were asked "How would you rate your current competency in

research" and given a choice of below average, average or above average, which was scored with a 1, 2, or 3, respectively. As shown in Figure 4A, students scored their confidence in research significantly higher in the post-survey, than in the pre-program survey in both 2009 and 2010. Comments in the post-survey about research included. *"Before this program, I knew nothing about research but now I feel like I know a lot! It was good to have both bench top and community focused students in the program so each of us could learn a little about the other types"* and *"I believe I now have a solid foundation about what research is. Without the other components of the class such as the annotated bibliography, the journal club, the grant proposal, and the final paper I would not have had such a solid grasp. These aspects really helped build my knowledge and competency."* Statistical competency was also analyzed in the survey. This topic was not covered during class and there is no change in perceived competency pre- and post-program survey with most students scoring themselves "average" or "below average" in this measure (Figure 4B).

Figure 4: Student perception of competency in research, statistics, oral presentation skills and scientific writing for 2009 and 2010 USDA Scholars at Virginia Tech. The Pre-survey was given prior to the start of the summer program, by at least one week. The Post-survey was given at least one week following the end of the summer program. (A) Mean + standard deviation Pre- and Post-survey scores for the question "How would rate your current competency in research?" (B) Mean + standard deviation Pre- and Post-survey scores for the question "How would you rate your statistical knowledge?" (C) Mean + standard deviation Pre- and Post-survey scores for the question "How would you rate your proficiency in public speaking?" (D) Mean + standard deviation Pre- and Post-survey scores for the question "How would you rate your writing proficiency?" Data is reported using a scale where 1=below average, 2=average, 3=above average.

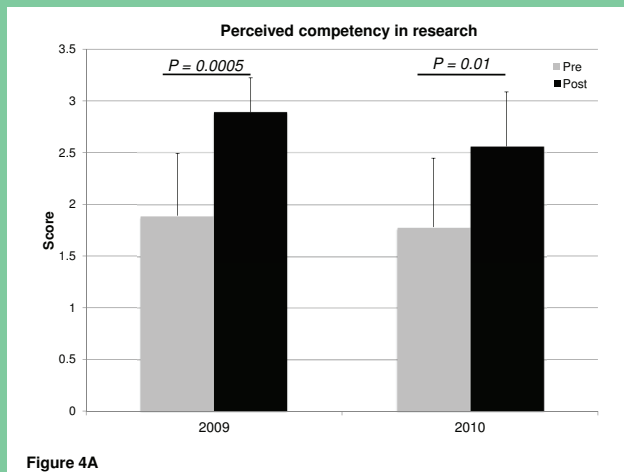


Figure 4A

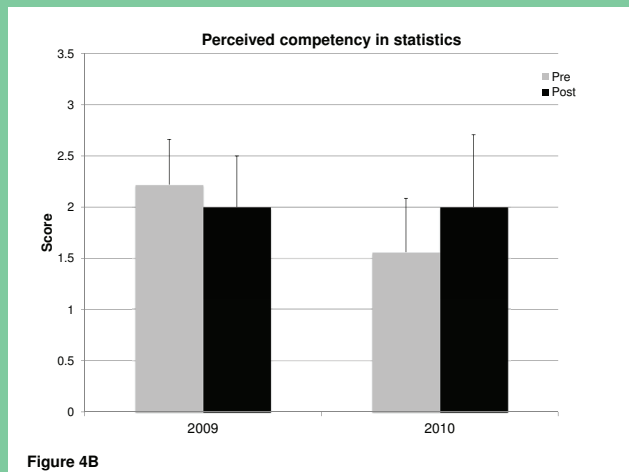


Figure 4B

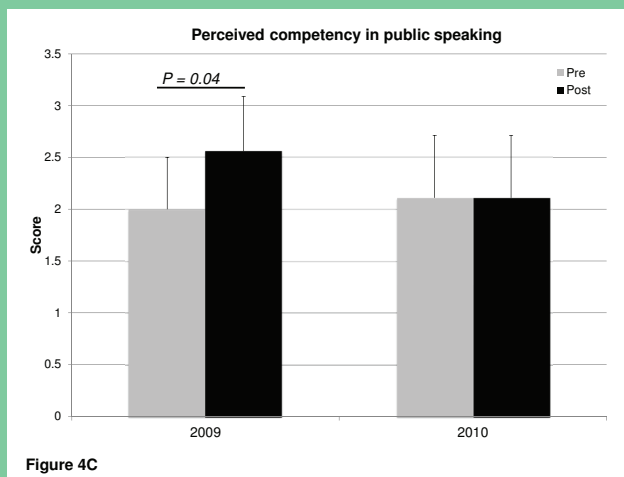


Figure 4C

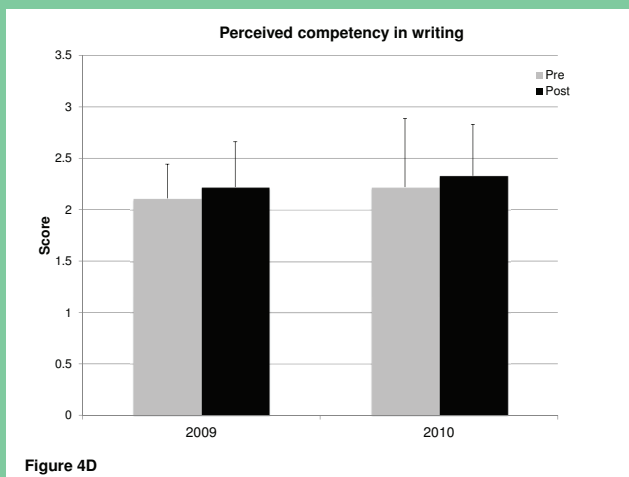


Figure 4D

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Students were also asked about their public speaking skills, both at the beginning of the semester when they were first asked to give a short overview of their project and at the end of the semester when they were asked to give a full seminar and poster session. Initially, students made comments such as *“next time I will try to be more conscientious of my images and figures to sure (sic) visibility for everyone in the room”* and *“I could have explained my methods a little more clearly and not used such dark slides .”* Another student initially stated that *“I was somewhat disappointed with my presentation and I know I could have prepared better”* during the initial presentations, but for the final presentation stated *“I have prepared more extensively and practiced numerous times.”*

In general, students actually felt more nervous about giving the final presentations than they did giving the initial ones. These feelings were not necessarily reflected in the post-surveys, which asked the question “how would you rate your proficiency in public speaking.” For the 2009 cohort, there was a significant increase in score reflected in the post-survey results. However, in the comments section of the 2009 survey, students stated that *“This program gave me more confidence when I am public speaking, but I still feel shaky at times when I am presenting”* and *“I’m still not completely comfortable speaking in public but this experience has helped to relieve (sic) a lot of anxiety about public speaking,”* which may help to clarify why the increase was so small, and only increased in one of the two years assessed.

Writing skills were also emphasized during the course and the overall summer program with the preparation of annotated bibliographies, poster abstracts, grant proposals and final papers. However, we found no significant increase in score in either year of the program (Figure 4D). The comments within the pre- post-surveys may provide some clue as to this lack of change in writing proficiency. For both years, in the pre-survey, students commented and scored themselves with strong writing skills. However, once they were exposed to scientific or technical writing style, as required for the grant, final paper and abstract, they lost some confidence in their writing skill. For example, one student commented in the pre-survey that *“In regards to my techinal (sic) writing, I feel very confident”, but in the post-survey wrote “Scientific Research Writing is a whole new beast.”*

Faculty survey data were collected for program years 2007-2011. In all years, the most frequent concern stated by faculty in taking a USDA Scholar for the summer program was time (15 out of 24 responses; 63%). Suggestions for improvement to the program included involving the mentors more in the program and classroom training topics (four comments), reducing the

number of classroom hours and/or assignments, so that the students could devote more time to research (three comments), involving the student in the lab in the prior semester (one comment, 2008 only and a change based on this comment was implemented in 2009-2012) and giving more guidance for the grant proposal, specifically the allowed amount of mentor input (two comments in 2008, and this change was implemented in 2009-2010). Comments on the overall program included *“The program was great and extremely well designed to mimic a true research experience, starting with a proposal and going all the way through a presentation and paper”* and *“The coordinators do an excellent job of providing an overview of research (IRB, statistical analysis, research design) and different research within our department. They act as excellent mentors to the students throughout the process too. The program is well-organized and a great asset to faculty and students who participate.”*

Unresolved Issues

There were several issues that remain unresolved. First, faculty time remains the primary concern in the program. Most faculty feel that the time invested in mentoring students may not translate to direct research outcomes (grants and papers) for their program. This sentiment appears to be common among other reports of undergraduate research programs, especially at research-intensive universities. For example, some institutions continue to value research productivity over undergraduate mentoring, especially in regards to promotion and tenure issues (O’Meara and Braskamp, 2005). At some institutions, especially research-intensive institutions, teaching grants are not considered “research” even if considerable scholarly investigation will be conducted during the grant period. At Virginia Tech, the formation of a new Office of Undergraduate Research may help in promoting teaching activities, especially involving undergraduate research-intensive courses, as scholarly activities for faculty. In support of this, it has been suggested that faculty mentoring of undergraduates occurred more readily at institutions where undergraduate research was valued both by colleagues and administration, than at those institutions where it was not valued (Eagan et al., 2011).

A second unresolved issue, which also presents concerns for many summer undergraduate research programs, is the funding source, especially for student stipends. Some of the first federal funding for undergraduate research occurred in 1965, and since then there has been significant growth in money available for these program (Donovan et al., 2010). However, programs are usually defined in the number of years of available funding and then either need to get another grant, or find

other funding sources. The USDA Scholars Program was originally funded for three years with a USDA Higher Education Challenge Grant. Subsequent years have used internal (department, college and institute) and faculty money, which need to be secured every year without any guarantee of continuity. The formation of an Office of Undergraduate Research at Virginia Tech has resulted in increased coordination of programs, and some travel money for undergraduates. Still, money for research stipends remains the major expense and the concern for program directors.

Summary

We describe the qualitative and quantitative results from assessment of an undergraduate research program “The USDA Scholars Program” at Virginia Tech, funded by a USDA Higher Education Challenge Grant, with matching and internal funds from Virginia Tech entities. Overall, this undergraduate research program represented a significant advance from previous programs that the authors were aware of, either at Virginia Tech, or at other universities. For example, a strong program in Food Science, with many similarities to ours still did not use a the semester prior to the summer research program to “jump start” students, mainly because this program attracts students both from and outside of the hosting institution (Roberts et al., 2010). The use of the semester prior allowed students in the USDA Scholars Program to complete IACUC and IRB training and write a referenced proposal prior to the summer research program. While the downsides of this include additional time and effort by both the student and the faculty member in the spring semester, neither students nor mentors commented on that time as burdensome.

There were no other identified programs that used a weekly student blog to document student concerns and/or reflections and only one other program included that we found included both pre- and post- surveys of the students to document gains (Gum et al., 2007). We believe that both of these components of the USDA Scholars Program contributed to its success both with the department and the university, as changes could be made immediately (for example, if more than one student had similar concerns on the blog) and yearly (based on the pre- and post-surveys of faculty and students).

Overall, between 65-68% students participating in the USDA Scholars Program during different program years self-assessed themselves with a significant increase in research confidence. This increase is similar to those reported in other articles (Sadler and McKinney; 2010, Seymour et al., 2004). In addition, 12% of the Scholars have published research papers in peer-reviewed journals to date and 36% have presented posters as local,

national and international meetings (in addition to the USDA Scholars symposium that was part of the USDA Scholars Program). Most Scholars (74%) continued research in the following academic year and this is similar to other described programs (Cameron et al., 2012; Gum et al., 2007; Kinkel and Henke, 2006; Levis-Fitzgerald et al., 2005; Martinez, 2009; Nnadozie et al., 2001; Roberts et al., 2010). Overall the department saw a significant increase in total numbers of students doing both regular and honors-level undergraduate research in the academic years following the program. Finally, and consistent with other published reports, there were an increased percentage of students going on to graduate school, compared to HNFE graduating seniors in general (Cameron et al., 2012; Kinkel and Henke, 2006; Nnadozie et al., 2001).

Conclusions and Implications

We believe that the USDA Scholars Program represents a model that can be translated to other undergraduate departments that want to start or improve a summer undergraduate research program. Specifically, innovations in using the semester prior to the summer program to “jump-start” student involvement in the research, a student blog with reflections and both pre- and post-surveys to the students are improvements over most published programs. Institutional and faculty support of any undergraduate summer research program is essential to success.

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Modeling Teaching Techniques: Preservice Nonformal Educators' Adoption of Techniques that will Influence Employability of their Future Audiences



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Abstract

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. Specifically, the study was designed to describe preservice nonformal educators' use of teaching techniques in their university microteaching laboratory, given the instructor-modeled teaching techniques used during class sessions. In addition, the researchers sought to describe preservice nonformal educators' critical cognitive processing given the teaching techniques observed and used by preservice nonformal educators. A census of fourteen students, who were pre-enrolled in the course, became the convenient population for the study. Three instruments were used to describe student use of teaching techniques, and student cognitive processing. Students were split into one of two groups prior to the first class session; one group received lower cognitive bonus questions, while the other group received higher cognitive bonus questions on all closing reflections during class sessions. Results were that five students used three of the instructor-modeled teaching techniques, timed-pair share, jot-thoughts and window-paning (Kagan, 1994), for a total of 12 frequencies of use, during the students' microteaching laboratories. In addition, no students scored higher than the lowest level of critical thinking during their critical cognitive processing on the reflections at the close of each class session.

Introduction

In March 2010, the unemployment rate was at 9.7%, as reported by the U.S. Bureau of Labor Statistics. Those without a job for 27 weeks or more increased to 6.5 million during that month. Teenagers were reported as the most unemployed working group at 26.1% (U.S. Bureau of Labor Statistics, 2010). During these uncertain economic conditions, educators must equip students with the skills they need for entering a changing and uncertain workforce. Some suggest that many of the skills that will be required for entering a changing workforce are those that are taught through the use of cooperative learning techniques for teaching.

Cooperative learning techniques offer students opportunities to work in small groups, a skill that most employers expect from new employees (Ravenscroft, 1997). Ravenscroft (1997) indicated that due to the nature of cooperative learning activities, students are teaching and coaching each other, which improves their learning while simultaneously improving their social interaction skills. Through the coaching and teaching of their peers, students are able to "*articulate their cognition and are able to observe and adopt the learning and study strategies of other students*" (p. 187).

According to Johnson and Johnson (1999), structuring learning situations cooperatively promotes students to work together to achieve group success. Consequently, when students work together towards a common goal, it typically results in higher achievement and greater productivity than if students work alone (Johnson and Johnson, 1999). Additionally, Johnson et

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al., (2007) wrote that cooperative learning results in a greater transfer of the content learned from one situation to another, higher-level reasoning, and meta-cognition.

Theoretical Framework

Three theories were used to build the theoretical framework; Piaget's Theory of Cognitive Development lays the foundation. Woolfolk (2007) explains Piaget's theory as a model for describing how humans think about a problem and their surroundings. Piaget's theory consists of four stages including sensorimotor, preoperational, concrete operational, and formal operational (Woolfolk, 2007). Accordingly, students in this study should be operating at the formal operational stage of cognitive development, and are therefore cognitively able to interpret the value of given teaching techniques to social development.

The second theory was Bloom's Taxonomy; Bloom et al. (1956) established a hierarchy of cognition comprising six levels. Theoretically, as one cognitively works through the hierarchy, each level demands the use of the lower cognitive levels. The six levels include: knowledge, comprehension, application, analysis, synthesis and evaluation. For this study, teaching techniques will be used that, theoretically, cause students to operate at the highest levels of Bloom's hierarchy. The original Bloom's hierarchy was chosen by the researchers so that comparisons could be made to previous student data collected using that taxonomy.

The third theory was the social interdependence theory, supporting that the achievement of each individual's goal in a group is effected by the other member's actions (Johnson and Johnson, 2007). There are two kinds of social interdependence; the first is positive, which encourages cooperation and the second

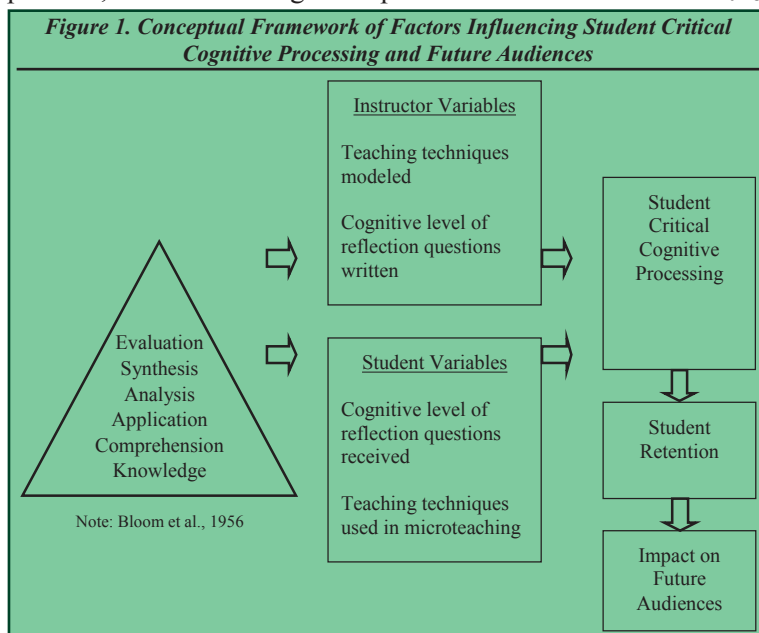
is negative, which encourages competition (Johnson and Johnson). Positive interdependence is when members of a group perceive they can only reach their individual goals when the other group members reach their goals. Negative interdependence exists when members of a group perceive they will only reach their individual goal when the other members fail to reach their goals (Johnson and Johnson). For the purposes of this study, the teaching techniques used will influence interdependence and cognitive processing.

Conceptual Framework

Two variables related to the instructor and two variables related to the students were examined in this study to describe teaching techniques used by the instructor and cognitive processing of the students across a 10-week university course (see Figure 1). The two variables, related to the instructor, were cooperative learning techniques modeled (Interdependence Theory) during class sessions and the cognitive level of reflection questions written (Bloom's Hierarchy). Student variables included the cognitive level of reflection questions they received (Piaget's Theory and Bloom's Hierarchy) and the cooperative learning techniques (Interdependence Theory) they used in their microteaching lessons. These variables were used to describe the student's critical cognitive processing during a 10-week university course.

Purpose and Objectives

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. Specifically, the study was designed to describe preservice nonformal educators' use of teaching techniques in the microteaching laboratory during a university Methods of Teaching in Non-formal Environments course, given the instructor-modeled teaching techniques used during class sessions. In addition, the researchers sought to describe preservice nonformal educators' critical cognitive processing when answering higher cognitive level questions, given the teaching techniques observed by the study participants and then used during their microteaching laboratory sessions. It was expected that preservice nonformal educators would implement new teaching techniques into their microteaching laboratory sessions once they saw them modeled in class. In addition, the researchers expected the teaching techniques modeled by the instructor and then adopted by the preservice nonformal educators, to influence the level of critical cognitive processing



evidenced in the responses to closing reflections during class sessions.

The following research objectives guided this descriptive study:

1. To describe observed student use of instructor-modeled teaching techniques during microteaching laboratories.

2. To describe student critical cognitive processing when responding to higher cognitive level reflection questions.

Review of Related Literature

Cooperative Learning

Cooperative learning is the incorporation of students working in groups to accomplish the same goal (Gillies, 2007). However, not all group work is effective cooperative learning. Instead, by using various techniques, the instructor should guide cooperative learning; if done properly, cooperative learning can contribute to student achievement (Gillies, 2007). Also, to ensure effective cooperative learning is taking place, individual performance, not just group performance, should be checked frequently to insure that all students are contributing to the group (Johnson and Johnson, 1999).

Responsibilities of cooperative-based group members include: ensuring positive academic progress is taking place; holding each other accountable for the learning; and providing each member with support and assistance to accomplish the goals (Johnson and Johnson, 2007). The three responsibilities listed here, along with social skills and group processing, are identified by Johnson and Johnson (1999) as the five essential elements of cooperative learning.

Gillies and Boyle (2010) examined perceptions of 10 middle school teachers when implementing cooperative learning in their classrooms. Gillies and Boyle interviewed the participating teachers, after each had embedded cooperative learning techniques into two units of instruction, both lasting 4-6 weeks. During the interviews, the teachers reported they had a positive experience incorporating cooperative learning. Comments mentioned were that students not only learned to interact with one another, but were also willing to take risks with their own learning (Gillies and Boyle). Teachers saw additional benefits of cooperative learning, including better management and structure of their lessons. Some issues reported in the implementation of cooperative learning were: student socializing, time management and the organization required on the teacher's part. Most of the teachers suggested cooperative learning be used more widely, while a few indicated it was a *"challenge and required commitment on the part of the teacher*

if it (cooperative learning) was to be implemented effectively" (Gillies and Boyle, p. 938).

Critical Thinking

Critical thinking is defined by Wiederhold and Kagan (1992) as *"a set of abilities and behaviors that allow students to look beyond the information presented, make connections, develop cognitive organizers, and create personal meaning"* (p. 201). When involved in critical thinking, one engages in metacognition, which is the ability to self-think through a process and create a strategy to obtain the information needed to complete the problem-solving situation (Wiederhold et al., 2007). Woolfolk stated, *"this knowledge is higher order cognition used to monitor and regulate cognitive processes such as reasoning, comprehension, problem-solving, learning and so on"* (p. 267).

Higher Cognitive Questioning

Higher cognitive questions are characterized by two factors; the first is that students are required to state predictions, solutions, explanations, evidence, interpretations, or opinions; and the second is that the answer should not be readily available to them from the curriculum taught (Gall et al., 1978). Newmann (1987) defined higher order thinking as a result of higher cognitive questioning or teaching, as the opportunity one is given to interpret, analyze, or manipulate information, because the solution cannot be found through the routine application of previously learned content. Newman stated that, lower order thinking involves repetitive behaviors, such as memorizing and inserting a solution. Therefore, questioning students at higher cognitive levels stimulates cognitive skills and moves them beyond memorizing content (Gall et al., 1978).

Methods

Population and Sample

Students enrolled in a Methods of Teaching in Non-formal Environments course were the convenient population for the study. All students (N=14) agreed to allow samples of their work to be reviewed for the purpose of the research (approved by the Behavioral and Social Sciences Institutional Review Board #2009B0405). Students enrolled in the course were preservice nonformal education students, so they were preparing to be extension educators and community and industry leaders. The majority of the students (n=8) were Agricultural and Extension Education majors in the Extension option. Five students were working toward an agricultural education minor. One study abroad student from England requested to audit the course. All students, except the study abroad student, were required to take the

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course to fulfill either their major or minor curriculum requirements for graduation. As such, this population of students is well-positioned to learn cooperative learning techniques, so they can use the skills developed by the techniques to influence their audiences throughout their careers.

Instrumentation

Closing Reflections

The researchers used three instruments to collect data for this study. The first was, closing reflections that the students received at the end of each class session. The class was split evenly into two groups. The first group (n=7) received a lower cognitive bonus question (knowledge or comprehension level question) on each closing reflection, while the second group (n=7) received a higher cognitive bonus question (analysis, synthesis or evaluation level question). Only the higher cognitive questions were evaluated using a critical thinking rubric; the lower cognitive questions were evaluated as right or wrong. Each bonus question on the closing reflection was created using the Florida Taxonomy of Cognitive Behavior (Webb, 1968). Inter-rater reliability was established by the researcher writing the question and another researcher independently, each class day, obtaining agreement on the cognitive level of questions that were being asked. The researchers established 100% agreement across the ten-week university course. A panel of experts in the field of teacher preparation and agricultural education reviewed the reflection questions to determine content validity of the questions used in the research. The panel determined the questions to be appropriate for assessing the cognitive level purported to be measured.

Critical Thinking Rubric

The second instrument was the critical thinking rubric for which the researchers used the Florida Rubric for Assessing Critical Thinking Skills (FRACTS) (Friedel et al., 2008) to evaluate student responses on all higher cognitive bonus questions. An expert panel of researchers in critical thinking developed FRACTS; this panel of experts set out to determine the essential elements of each critical thinking skill: analysis, evaluation and inference (Friedel et al.). The focus of the instrument was examining the process of critical thinking, instead of the product; it can be used in both audible and written responses. For the purpose of this study, written responses were examined.

Within the three constructs defined by FRACTS, analysis, evaluation and inference, there are six descriptors, creating a total of 18 descriptors. When evaluating a response, each descriptor received a score

of one, two, or three; A score of one indicated that the individual showed no evidence of demonstrating or using the specific critical thinking skill. The score of two indicated that the individual provided hints of using the specific critical thinking skill.

Finally, the score of three indicated that the individual clearly demonstrated the specific critical thinking skill. The total range of scores for FRACTS is 18 to 54; within the three constructs, the range of scores is 6 to 18. The recommended interpretation of both the construct and total scores received on FRACTS, can be found in Table 1 and Table 2 respectively.

Table 1. Interpretation on each Construct Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)

Construct Score	Interpretation
6 to 9	Low level of critical thinking
10 to 14	Common level of critical thinking
15 to 18	High level of critical thinking

Note: Friedel, personal communication, April 13, 2010.

Table 2. Interpretation of Total Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)

Construct Score	Interpretation
18 to 28	Low level of critical thinking
29 to 43	Common level of critical thinking
44 to 54	High level of critical thinking

Note: Friedel, personal communication, April 13, 2010.

Validity for FRACTS was established by an expert panel of researchers in critical thinking (Friedel, personal communication, April 13, 2010). For this study, reliability for the critical thinking rubric instrument was established using test-retest procedures (Ary et al., 2002). The researchers re-analyzed randomly selected closing reflections using the critical thinking rubric. *A priori*, a 95% confidence band was established as acceptable for each closing reflection. Upon one test-retest measure, the researchers had achieved the acceptable rate (95%) for both inter-rater and intra-rater reliability.

Microteaching Lab Videos

The third instrument used was the microteaching lab videos of each student. Students were required, as part of the course, to participate in microteaching labs, in which they developed daily plans and taught the content to their classmates. The researchers retained a copy of these videos, with permission from the students, in order for the researchers to analyze the microteaching laboratory lesson. Each student's lesson was analyzed, with a frequency count, for the use of the teaching techniques that had been demonstrated by the instructor during class sessions.

Reliability for the microteaching lab videos was established using test-retest procedures (Ary et al., 2002). The researchers reanalyzed randomly

selected microteaching videos. Intra-rater reliability for the microteaching lab videos was established for the researcher by analyzing a randomly selected microteaching lab video. Five weeks later, the same researcher reanalyzed the same microteaching lab video. *A priori* a 95% confidence band was established as acceptable. Upon one test-retest measure, the researcher had achieved the acceptable rate (95%).

Data Collection and Analysis

Closing Reflection

At the end of each class session, the graduate student researcher always handed-out the closing reflection, to ensure that each student received the correct cognitive level of question (according to the group to which he/she had been randomly pre-assigned). To help combat any researcher bias, an undergraduate student employee in the department graded all of the reflections (students were assigned numbers so anonymity was maintained). After the reflections were graded, a copy was filed in the research records; the original was returned to the student.

FRACTS

Both the graduate student researcher and the undergraduate student employee evaluated the closing reflection using FRACTS. Each rater received training from another researcher with extensive experience in the use of FRACTS. Training involved an explanation of the instrument followed by practice evaluating several closing reflection responses. The trainer was present during the first practice rating to answer questions for the raters. After the training, inter-rater reliability (a measure of rater consistency) was assessed by using fourteen closing reflection questions. The researcher calculated the percent agreement between the coders, which reflected an inter-rater reliability of 93.

Microteaching Lab Videos

Three strategically selected lecture sessions for the Methods course were taught using purposefully selected cooperative learning techniques. All of the students received the same instruction. The graduate student researcher gave these lectures so the students could easily distinguish between the lecture sessions in which the cooperative learning class sessions were taught and the other class sessions. Three to five of the following teaching techniques were used during each strategically selected class session: jot thoughts, paraphrase passport, timed pair-share, inside-outside circle, Q-approach, send a star and window-paning as described by the Kagan (1994) curriculum of cooperative learning techniques.

Student use of the instructor-modeled teaching techniques, during their microteaching laboratories, was collected as a frequency count. The researcher watched each student’s microteaching lab video and recorded the frequency of use of cooperative learning teaching techniques.

Following the data collection period, all student responses and observations were entered into the Statistical Package for the Social Sciences 17.0 (SPSS 17.0). Appropriate measures of central tendency, variability, frequency counts and percentages were generated for each characteristic of interest in the study. The SPSS 17.0 was used to run all analysis of the data for the study. The unit of analysis for this study was post-secondary students (N=14). The SPSS program was designed especially for analyzing data collected in studies related to social and behavioral research.

Table 5. Instructor-modeled Techniques Used by Students during Microteaching Laboratories

Technique used	Frequency
Timed-Pair Share	9
Jot-Thoughts	2
Window-Paning	1

Results

Student Use of Instructor-Modeled Teaching Techniques during Microteaching Laboratories

Findings were, that out of the 27 microteaching lessons recorded, 12 frequencies of use of the instructor-modeled teaching techniques were recorded for five of the fourteen students. Out of the seven cooperative learning techniques modeled by the instructor, three were used by the students during their microteaching laboratories: timed-pair share, jot-thoughts and window-paning. In Table 5, the frequency of techniques used during microteaching by the five students is recorded.

Critical Cognitive Processing When Responding to Higher Cognitive Level Reflection Questions

Student responses in the higher cognitive questions group were analyzed using FRACTS. Data were reported missing when students chose to not answer the question, or were absent for the day. A total of ten closing reflections were reported as missing data, leaving 89.8% of the closing reflections to be analyzed. On average, student responses to the higher cognitive questions scored 18.9 on the critical thinking rubric (range = 18 to 28).

Conclusions/Recommendations/ Implications

Use of Instructor-Modeled Teaching Techniques

Students did not tend to use the instructor-modeled teaching techniques during microteaching lessons after seeing them modeled by the instructor during class sessions. The teaching techniques used during microteaching laboratories were timed-pair share, jot-thoughts and window-paning. A description of each cooperative learning teaching technique follows:

Jot thoughts: Consists of splitting the class into groups of any size. Once the groups are formed, the instructor provides each group with slips of paper for them to jot their ideas. Once the groups are given a task/question they put only one idea on each slip of paper, but they should also try to fill the surface of their desk with as many ideas as possible. No slip of paper should overlap another (Kagan, 1994).

Timed-pair share: Allows students a specified amount of time to share their thoughts about a given topic. Once the time has expired, they spend the same amount of time listening to their partner's idea, giving both students an equal amount of time to share and voice their opinions (Kagan, 1994).

Window-paning: Allows students to conceptualize an idea visually. Instructors discuss and breakdown a situation, process and story line into smaller bits of information. The students have in front of them a sheet of paper divided into the number of sections needed for the content being delivered. As the instructor presents the information, the students draw a picture that will help them remember that part of the process. Once the content has been delivered, students break into groups and verbally explain the content material they drew in their windowpanes (Kagan, 1994).

Professors teaching methods classes to preservice nonformal educators need to be purposeful about sharing the names of the teaching techniques being used during class sessions, as well as the reasons for the selection of the techniques; for example, sharing with the preservice educators the employability skills that the technique develops could influence the adoption of the use of the technique. Professors must then indicate that they are expecting the preservice educators to use the technique(s) in microteaching laboratories. This level of purposeful approach will impact the adoption of future use of these techniques for teaching employability skills to various audiences. Also, if a portion of the microteaching scoring rubric is designed to reflect a grade for the use of the instructor-modeled teaching techniques, adoption rate will increase among the preservice nonformal educators.

Student Critical Cognitive Processing

Students in the higher cognitive group answered reflection questions at the lowest level of critical thinking. Therefore, educators should teach to and assess students at the level of cognition that is stated in the daily lesson objectives. Crowe et al., (2008) stated that if educators are teaching at higher cognitive levels, but testing only at the knowledge level, students assume that they really do not need to put forth as much effort at the higher levels. In addition, if educators teach at the knowledge level, but test at higher levels, students often perform poorly because they have not had the opportunity to cultivate higher level thinking skills. Whittington and Newcomb (1993) recommended that students be tested at higher cognitive levels only after the students have received instruction that was delivered (modeled) at the higher cognitive levels.

When preparing future nonformal educators to use techniques that influence employability skills, Gillies and Boyle (2010), stated they should be "trained in the skills needed to implement cooperative learning in their classrooms" (p. 938), including using structured cooperative activities, creating challenging tasks and being able to teach students the social skills needed to effectively work in groups. Ravenscroft (1997) indicated that research conducted on cooperative learning shows positive achievement in students. Not only will students put forth more effort to achieve a goal when participating in structured cooperative activities, they will also develop positive and supportive relationships (Johnson and Johnson, 1999). When engaging in cooperative learning activities, students are able to observe outstanding group member behaviors and emulate them to become better students themselves (Johnson et al., 2007). Adoption of these teaching techniques will influence the level of employability skills role-modeled to future learners.

Discussion and Further Research

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. To accomplish the purpose of the study, researchers chose an agricultural education methods class, since the enrollment for the course was preservice nonformal educators. The researchers expected that students would implement new teaching techniques into their microteaching laboratory sessions simply because they saw them modeled in class and, therefore, would want to add them to their teaching repertoire. The expectation was not met.

In addition, since the researchers strategically selected very specific teaching techniques that had a brain-based reputation, the researchers expected

the teaching techniques modeled by the instructor to influence the students' level of critical cognitive processing. In addition, the researchers thought that student adoption and use of the techniques would further influence student critical cognitive processing. The techniques were not influential to student critical cognitive processing and, without adoption and use of the techniques, no opportunity existed for further influence on critical cognitive processing.

More research needs to be conducted, with a larger population, to further examine the relationship of instructor-modeled teaching techniques to preservice nonformal educators' use of techniques that influence employability of their future audience members. Preservice nonformal educators in this study were not required to or asked to use the instructor-modeled teaching techniques because the researchers wanted to see if and how often the preservice educators used the techniques in their own teaching after simply observing the techniques used in lecture. In a future study, researchers will design the study such that students are required to use the instructor-modeled techniques in their microteaching. The study will also be conducted across a longer period of time such that the potential for influence is greater.

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Response-Shift Bias in Critical Thinking¹

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Abstract

Students' responses to the EMI Critical Thinking Test were examined for response-shift bias, a phenomenon found in previous studies using tests of other constructs in which participants provided inconsistent responses in pre-tests compared to then-tests. Pre-test scores of a sample of 75 students enrolled in animal science courses at the University of Florida were compared to the students' then-test scores, which were obtained upon completion of the course and consisted of self-reports of students' prior critical thinking skills. Comparison of the pre-test scores and then-test scores in this study did not provide evidence of a response-shift bias. The influence of demographic variables including gender and ethnicity was also examined and results indicated that the appearance of response-shift bias was not impacted by either variable. The results of this study were not consistent with limited previous research and future studies should further investigate the phenomenon of response-shift bias with respect to the EMI Critical Thinking Test as well as other self-report tests.

Introduction

Frequently in educational research, it is necessary to evaluate perceptions, knowledge, attitudes and behaviors of participants as they relate to a treatment. Self-reports of these constructs are often provided using a pre-test-post-test research design. Comparisons can then be made between the respondents' perceptions at the start of treatment and upon completion, allowing researchers to determine the effect of the treatment on the participants.

In some instances, however, obtaining a pre-test from participants may not be practical or feasible. Additionally, concerns have been expressed regarding the ability of participants to accurately self-report prior to a treatment due to their lack of knowledge surrounding the subject of interest (Rockwell and Kohn, 1989). The testing effect may also pose a threat in pre-

test-post-test designs, as research has shown that a pre-test can improve learning which is reflected in the post-test (McDaniel et al., 2007). Ary et al. (2010) have described pre-test sensitization as a threat to validity for attitude and personality inventories, resulting in students carefully considering their responses and changing their answers based on self-reflection and not necessarily on the effect of the treatment. Such instances may call for a post-then design, in which participants provide their self-report of pre-treatment knowledge or perceptions (then) at the same time as their post-treatment knowledge or perceptions (post).

Response-shift bias has been identified as a potential threat to the validity of pre-test-post-test research designs. Howard and Dailey (1979, p. 145) defined response-shift as "the difference between pre and then self-report ratings." Several studies have noted a response-shift in participants' responses (Howard and Dailey, 1979; Rohs, 1999). As a result, researchers have recommended that post-then data be collected in addition to pre-test data for all studies using self-rating measurement methods (Howard and Dailey, 1979; Rohs, 1999) before and after treatments.

One such study, conducted by Howard and Dailey (1979), tested for response-shift bias using a seven-item questionnaire to evaluate interviewer skills before and after a five day workshop. Twenty-one individuals participated in the study and completed a pre-test as well as a post-then-test. In addition, the researchers taped first and last practice interviews of each of the participants and trained judges rated the behavior of each on a 9-point scale. A response shift was discovered in the participants' self-reports on four of the seven items. Further, it was noted that the then-test reports were more closely aligned with the ratings assigned by judges as opposed to the pre-test reports. While a cause for the response shift was not investigated in this study, the shift was observed. The then-test scores were found

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to be more accurate representations of interviewer skills than pre-test scores (Howard and Dailey, 1979).

This phenomenon was investigated later by Rohs (1999). Students in an undergraduate agricultural leadership course participated in a similar study using the Youth Leadership Life Skills Development Scale in pre-post and post-then comparison (Rohs, 1999). A group of 30 students participated in a pre-post-test and 28 completed a post-then-test. The data appeared to indicate a response shift, as post-then students reported greater changes compared to the pre-post participants (Rohs, 1999).

In some cases, however, response-shift bias may not pose a threat. Sprangers and Hoogstraten (1988) tested the effects of a bogus-pipeline induction on response-shift bias in testing first aid knowledge of psychology students before and after a first aid film. Results from this research showed no response-shift in the bogus-pipeline experiment, fitting with the researchers' hypothesis. An unexpected finding was that response-shift had also not occurred in the non-bogus-pipeline component (Sprangers and Hoogstraten, 1988). This indicates that there may be certain circumstances under which response-shift bias is not a threat to validity for pre-test-post-test designs.

Although several studies have been conducted to test for response-shift bias (Howard and Dailey, 1979; Sprangers and Hoogstraten, 1988; Rohs, 1999), this phenomenon may not occur under all pre-test-post-test circumstances (Sprangers and Hoogstraten, 1988). Previous studies have looked at student groups as a whole, without providing any data on possible relationships between response-shift and student characteristics. This information may provide valuable insight into response-shift bias. This study investigated response-shift bias using the Engagement, Cognitive Maturity and Innovativeness (EMI) critical thinking test, considering demographic variables which included gender and ethnicity.

A pre-test-post-test analysis of EMI critical thinking test scores of students at the University of Florida was used to determine whether participation in animal science courses and activities impacted critical thinking (Miller et al., 2011). Results of this analysis demonstrated that as a result of participation in animal science courses and activities, students demonstrated improvement on the Innovation and Engagement scales. Then-test data were also collected from these students, but had not been analyzed in the study conducted by Miller et al. (2011). By analyzing the then-test data of these students, this study attempted to validate the results of the former study.

Methods

The purpose of this study was to determine if a response shift existed between then-test responses and pre-test responses of participants providing a self-evaluation using the EMI critical thinking test. Given this information, researchers may be more able to appropriately determine the accuracy of self-reports evaluated in both pre-then-post as well as post-then-pre designs.

The following objectives were used to guide this study:

1. Evaluate the difference between pre-test scores and then-test scores of the EMI instrument for students enrolled in classes at the University of Florida.
2. Evaluate the difference between pre-test scores and then-test scores of the EMI instrument based on demographics.

The population for this study consisted of students enrolled in the Introduction to Animal Sciences course ($n = 66$), as well as those enrolled in the Meat Selection and Grading ($n = 3$) and Live Animal Evaluation ($n = 6$) courses, at the University of Florida during the 2009-2010 academic school year. Each of the courses provided students with both lecture and laboratory instruction.

Participating students were asked to evaluate their critical thinking skills before and after one semester of participation in the courses. Ricketts and Rudd (2005) developed the EMI test to measure critical thinking disposition in a 26 item response test, consisting of 11 questions measuring engagement (defined as "students' predisposition... to use reasoning" p. 33), eight questions measuring cognitive maturity ("awareness... of their own and others' biases and predispositions" p.33) and seven questions measuring innovativeness (students' predisposition to seek truth). Cronbach's alpha scores of .79, .75 and .89 were given for Innovativeness, Cognitive Maturity and Engagement, respectively (Ricketts and Rudd, 2005). Students were administered the test at the beginning of the programs (pre-test); upon completion of the program, students were asked to fill out the instrument again, including their responses after the course or team activities (post-test). Following the post-test, the participating students were asked to evaluate their responses previous to enrollment or participation (then-test).

Data were then analyzed using SPSS® for Windows™ software. A paired t-test was used to compare pre-treatment responses given prior to participation (pre-test) with pre-treatment responses given after participation (then-test) for totaled values for the following constructs: engagement, cognitive maturity and innovativeness. The total values for the combined constructs were also compared using a paired t-test analysis. *A priori*, a

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significance level of $p < .05$ was set. Responses of each construct and the totals were also compared based on gender and ethnicity to determine what trends, if any, may have existed based on demographic information provided by the participants.

Results and Discussion

Objective One - Evaluate the Difference between Pre-Test Scores and Then-Test Scores of the EMI Instrument for Students Enrolled in Classes at the University of Florida.

The average score of participants' responses to the engagement portion of the EMI critical thinking test was $M = 43.83$ at pre-test and $M = 43.85$ at then-test. A p value of 0.96 indicated no significant difference between pre and then responses for this construct. Participants' measures of cognitive maturity were reported as $M = 30.73$ at pre-test and $M = 31.03$ at then-test. No significant difference between pre and then responses existed (p value = 0.44). Average values of $M = 27.75$ at pre-test and $M = 28.01$ at then-test were reported for innovativeness. A p value of 0.47 indicated no significant difference in response scores.

Table 1. Mean Pre and Then Scores of Critical Thinking Constructs

Item	Mean - Pre	Mean - Then	T	p
Engagement	43.83	43.85	-0.06	0.96
Cognitive Maturity	30.73	31.03	-0.77	0.44
Innovativeness	27.75	28.01	-0.72	0.47
Total	102.31	102.89	-0.61	0.54

Objective 2 - Evaluate the Difference between Pre-Test Scores and Then- Test Scores of the EMI Instrument Based on Demographics.

Male respondents' ($n = 19$) average score for the total EMI critical thinking test was $M = 104.26$ at pre-test and $M = 102.53$ at then-test. No significant difference between the pre and then-tests was determined based on a p value of 0.31. The average score of female respondents ($n = 56$) for the total EMI critical thinking test was $M = 101.64$ at pre-test and $M = 103.02$. A p value of 0.24 indicated no significant difference between pre and then-test scores.

The majority of participants were White ($n = 64$), with total average scores of $M = 101.75$ at pre-test and $M = 102.33$ at then-test. A p value was calculated at 0.57, so no significant difference existed between the pre and then-tests. The Non-White participants ($n = 11$) had similar results. Average scores were 105.55 at pre-test and 106.18 at then-test. The p value of 0.83 indicated that no significant change occurred in this group of participants either.

No significant differences were found between the pre-test scores and the then-test scores reported by participating students with respect to any of the constructs

Table 2. Mean Pre and Then Scores of Critical Thinking Constructs of Male Participants

Males	n	Mean - Pre	Mean - Then	t	p
Engagement	19	31.26	30.84	0.64	0.53
Cognitive Maturity	19	44.89	43.63	1.41	0.18
Innovativeness	19	28.11	28.05	0.08	0.94
Total	19	104.26	102.53	1.06	0.31

Table 3. Mean Pre and Then Scores of Critical Thinking Constructs of Female Participants

Females	n	Mean - Pre	Mean - Then	t	p
Engagement	56	30.55	31.09	-1.177	0.244
Cognitive Maturity	56	43.46	43.93	-0.821	0.415
Innovativeness	56	27.63	28.00	-0.846	0.401
Total	56	101.64	103.02	-1.194	0.238

Table 4. Mean Pre and Then Scores of Critical Thinking Constructs of White Participants

White	n	Mean - Pre	Mean - Then	t	p
Engagement	64	30.52	30.81	-0.715	0.477
Cognitive Maturity	64	43.63	43.69	-0.120	0.905
Innovativeness	64	27.61	27.83	-0.557	0.579
Total	64	101.75	102.33	-0.556	0.573

Table 5. Comparison of Mean Pre and Then Scores of Critical Thinking Constructs Non-White Participants

Non-White	n	Mean - Pre	Mean - Then	t	p
Engagement	11	32.00	32.27	-0.280	0.785
Cognitive Maturity	11	45.00	44.82	0.132	0.898
Innovativeness	11	28.55	29.09	-0.493	0.633
Total	11	105.55	106.18	-0.217	0.832

measured by the EMI test. Total scores likewise yielded no significant difference between pre and then scores. Average scores for the EMI critical thinking test in total at the time of pre-test was $M = 102.31$ and $M = 102.89$ at the time of then-test.

This study showed no evidence of response-shift bias. Within this sample, pre-test and then-test scores of participants demonstrated no significant difference in self-reports on the EMI critical thinking test administered ($p > .05$). No significant difference was reported in the individual components of the EMI critical thinking test, including engagement, cognitive maturity and innovativeness ($p > .05$). Additionally, analysis revealed no significant difference between pre and then reported scores of males compared to females ($p > .05$). Scores between pre and then reports of White students and Non-White students also showed no significant difference ($p > .05$). Demographic variables investigated in this study appeared to have no effect on the likelihood of response-shift bias for the participants.

The findings of this study contradict those of Rohs (1999) and Howard and Dailey (1979). As the study conducted by Sprangers and Hoogstraten (1988) indicated, response-shift bias may not threaten the validity of all tests. This may include the EMI Critical Thinking Test or possibly measures of the critical thinking construct. A deeper understanding of response-shift bias is needed, as well as how to address response-shift bias if it is found to be present. Relatively few

studies have investigated this phenomenon; therefore, research is needed to test whether response-shift bias exists as a threat to validity in pre-test-post-test designs using the EMI instrument, as well as other self-report measures. Tests used to measure perceptions of individuals with regard to animal welfare issues, use of genetically modified agricultural products and other issues faced by the agriculture industry could benefit from further investigation of response-shift bias.

Studies should continue to collect pre-test-post-test data in conjunction with post-test-then-test designs to verify results. Future research may also include demographic variables to determine whether factors such as gender and ethnicity affect response-shift bias when such a phenomenon is discovered. The impact of participant variables such as age and experience should also be considered in future research.

Summary

The purpose of this research was to determine if response shift occurred between participants' responses to the EMI critical thinking test before a treatment and a then-test following treatment. A total of seventy five students participated in the study. Participating students completed the EMI critical thinking pre-test at the beginning of the courses, as well as a then-test upon completion of the courses. The participants of this study were selected purposively and consisted of students enrolled in animal science courses at the University of Florida. Results therefore cannot be generalized outside of this population.

No significant differences were found between pre-test and then-test scores of participants selected for this study. Gender and ethnicity of the participants did not result in significant differences between pre-test and then-test scores. Response-shift bias was not a threat to the validity of the EMI Critical Thinking Test within the population selected for this study.

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Agricultural Education Students' Acceptance and Self-Efficacy of Mobile Technology in Classrooms

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Abstract

Mobile learning is a growing segment of e-learning as more students are regularly engaged in mobile technology use. The amalgamation of learning and mobile technologies, known as mobile learning, is a relatively recent phenomenon and a thorough framework of knowledge has yet to be developed. Researchers lack data on the factors affecting college and university students' acceptance of mobile learning. The need to gather this data is paramount to our understanding of how the use of mobile technology is changing learning for students in higher education. Agricultural educators and students would benefit from a greater understanding of the mobile learning and its part in agricultural education. The population of the study was undergraduate education students at Texas A&M University (N =687). The study used quantitative research surveys to evaluate students' acceptance of mobile learning and self-efficacy. Descriptive statistics were used to provide levels of students' mobile learning acceptance and self-efficacy. Students scored highest in the areas of self-efficacy and effort expectancy. Further studies should address the relationship between mobile learning acceptance and self-efficacy. The relationships determined by future research will help increase our knowledge of students' perceived capacity to learn via mobile technology.

Introduction

Literature Review

Mobile learning is an emerging educational phenomenon coming from the integration of e-learning and mobile technologies. Hashemi et al. (2011) defined mobile learning as the use of mobile technologies to expand the reach of teaching and learning to occur at any time or place. The advent of mobile learning will continue to test the idea of a traditional classroom and create inquiry regarding its educational potential (Kukulka-Hulme et al., 2009). Mobile learning has

transitioned from a subordinate method of e-learning into its own educational field with a need for devoted research (Pollara and Broussard, 2011).

The increasing use of mobile learning systems is creating a paradigm shift for e-learning. Mobile or m-learning provides significant learning prospects for students who regularly use mobile devices like smartphones (Gedik et al., 2012). Our current educational system will be greatly affected by the advent of this technology. Rajasingham (2011) found mobile learning could constitute an innovative and attractive paradigm for higher education and researchers should address its use. The increasing use of mobile devices for learning is a key development in distance education and future educational strategies (Chong et al., 2011). The prevalence of mobile technologies among students is transforming our educational system. The continued growth of mobile learning as an educational tool is dependent on its flexibility and pervasiveness (Iqbal and Qureshi, 2012). Mobile technology can be beneficial for higher education due to its ubiquitous nature and ability to shape information processes (Schepman et al., 2012).

Mobile learning can extend learning opportunities to students due to its flexibility and mobility. Liaw et al. (2010) suggested better frameworks for understanding mobile learning need to be created to provide educators and researchers with a better idea of its educational uses. The growth of this learning technology is being fueled by the unrelenting pace of technology as well as the need for educational institutions to harness it effectively. Educators are exploring the application of mobile technologies in our instructional settings due to the increasing omnipresence and accessibility of the technology (Walls et al, 2010). Mobile device use among students is pervasive and creating unlimited potential for mobile learning in our schools (Khaddage et al., 2009).

Mobile learning technology provides a unique opportunity for learning activities at the post-secondary level. Cheon et al. (2012) identified higher education as an appropriate venue for the integration of mobile learning because of the ubiquitous nature of mobile devices on college campuses. The use of mobile learning can expand the scope of higher education and allow it to better reach students. Mobile learning can provide a more interactive and effective type of learning to meet student needs (El-Hussein and Cronje, 2010).

Educators should develop an understanding of the factors in the acceptance of mobile learning technology and its effective implementation in our colleges and universities. Keskin and Metcalf (2011) indicated the promising future of mobile learning needs researchers to understand the meanings, methods and theories related to its study. Wang et al. (2009) found research into factors, such as age and gender differences, affecting the intention to accept mobile learning has been limited. Research into mobile learning usage helps us to gain a better understanding of students' practices and attitudes toward mobile learning (Bradley and Holley, 2011). Current research on mobile learning acceptance among undergraduate students is lacking. Habboush et al. (2011) suggested issues on how to promote learners' acceptance of mobile learning seem to be largely unsolved. The analysis of issues surrounding mobile learning adoption is deficient despite the continued growth of mobile learning (Liu et al., 2010). Researchers should study the factors affecting mobile learning as it can provide increased access to education without the limits of geography and time (Wang et al., 2009). Agricultural educators need to examine the effect of innovative technologies on students and in classrooms. Rhoades et al. (2009) recommended future studies assess the usefulness of computer and communication technologies in agricultural education settings. Leggette et al. (2012) found that agricultural education faculty should be informed about new technologies and develop the ability to incorporate these technologies into their instruction in order help students engage in educational growth.

Theoretical Framework

The theoretical framework for this study builds upon the components of self-efficacy theory and the unified theory of acceptance and use of technology. Social Cognitive Theory provides a framework for understanding, predicting and changing human behavior. Bandura's (1986) theory suggests the interaction of personal factors like behavior and environment define human behavior. Self-efficacy is a part of Social Cognitive Theory and plays a large role in how individuals handle

a variety of undertakings. Bandura (1977) defined self-efficacy as how much effort an individual will put forth in facing challenging endeavors. Individuals with high self-efficacy will use great effort in attempting to master demanding situations while individuals with low self-efficacy will avoid attempting such situations (Bandura, 1993).

Davis (1989) built upon Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA) and devised the Technology Acceptance Model (TAM). The model is an information systems model indicating how users accept and use technology. Venkatesh et al. (2003) used TAM as basis for the Unified Theory of Acceptance and Use of Technology (UTAUT). The theory uses TAM as well as other theories and models such as TRA, Azjen's (1991) Theory of Planned Behavior (TPB), Bandura's (1986) Social Cognitive Theory (SCT) and Rogers's (2003) Innovation Diffusion Theory (IDT) in its framework.

Four key constructs explain user intentions and usage behavior toward an information system in UTAUT. Performance expectancy, effort expectancy, social influence and facilitating conditions determine information system use (Venkatesh et al., 2003). Performance expectancy measures user belief in the ability of the information system to improve job performance. Effort expectancy measures user belief in how easy it is to use the information system. Social influence measures how the user perceives others importance of using the information system. Facilitating conditions measures how the user believes the necessary infrastructure is in place to use an information system (Venkatesh et al., 2003).

Objectives

The research study was designed to assess undergraduate education students' performance expectancy, effort expectancy, behavioral intention and self-efficacy in relation to mobile learning. More specifically, this study sought to:

1. Describe students' performance expectancy, effort expectancy, and behavioral intention in regards to mobile learning; and
2. Describe students' self-efficacy in regards to mobile learning.

Materials and Methods

The study used quantitative research and descriptive statistics to provide solutions to the research questions. Quantitative research is used to analyze and interpret data through statistical procedures to communicate results (Ary et al., 2006). Descriptive statistics were used to analyze the constructs of performance expectancy, effort expectancy, behavioral intention and self-efficacy in the

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form of Mean Weighted Discrepancy Scales (MWDS). Descriptive statistics allow researchers to organize, summarize and describe observations (Ary et al., 2006). The study was deemed exempt by the Texas A&M University Institutional Review Board and was assigned protocol number 2011-0426.

The study use a population of undergraduate students enrolled in agricultural education courses at Texas A&M University. A stratified random sample (N = 687) was utilized to address the study's objectives. An instrument combining a Teacher Sense of Efficacy Scale (TSES) and a UTAUT scale was created to collect the data. Ex post facto calculation of internal consistency and reliability produced the following reliability coefficients: performance expectancy = .92; effort expectancy = .91; behavioral intention = .97; and self-efficacy = .95.

Survey research was conducted through the use of paper questionnaires handed out in class to collect data. Survey research is used by researchers to determine specific characteristics of a particular group and summarize the findings. Researchers can get an idea of a group's attitudes and beliefs from these findings (Fraenkel et al., 2012).

The TSES was used to create the self-efficacy part of the combined instrument. Tschannen-Moran and Hoy (2001) created the TSES using Bandura's (1993) Social Cognitive Theory. Their instrument used a nine-point summated scale for each item, with the following: anchors at 1 = nothing, 3 = very little, 5 = some influence, 7 = quite a bit and 9 = a great deal (Tschannen-Moran and Hoy, 2001). Venkatesh et al. (2003) UTAUT scale was used for the mobile technology preference section of the combined instrument. Mobile technology preference was measured on a seven-point summated scale: where 1 = strongly disagree, 2 = moderately disagree, 3 = somewhat disagree, 4 = neutral (neither disagree nor agree), 5 = somewhat agree, 6 = moderately agree and 7 = strongly agree. The instrument contained a definition of mobile learning. Students were not measured on engagement in formalized mobile learning.

The majority of participants were male (n = 196, 65.10%), classified as seniors (n = 195, 65.00 %), worked part-time (n = 146, 48.7) and carried a GPA

between 2.99 and 2.50 (n = 121, 40.30%). The findings were not generalizable to the target population. However, the results do offer insight into the areas of performance expectancy, effort expectancy, behavioral intention and self-efficacy in terms of mobile learning acceptance.

Results and Discussion

Results

Descriptive statistics were used to measure respondents' scores. Data frequencies were not provided due to the kurtosis and skewness were non-factors as the data was normally distributed. Participant demographics were not found to be significant regarding mobile learning acceptance. Self-efficacy (M = 5.24, SD = 1.37) was the highest scoring construct. Behavioral intention (M = 5.02, SD = 1.66) was the lowest scoring construct.

The first objective of the study was to describe undergraduate agricultural education students' performance expectancy in relation to mobile learning (see Table 1). The items that received the highest scores were "Using mobile learning enables me to accomplish tasks more quickly." (M = 5.29, SD = 1.52) and "I would fine mobile learning useful in school." (M = 5.24, SD = 1.60). The item with the lowest scores was "If I use mobile learning I will increase my chances of getting a good grade." (M = 4.74, SD = 1.48).

Part of the first objective of the study was to describe undergraduate agricultural education students' effort expectancy in relation to mobile learning (see Table 2). The items with the highest scores were "I would find mobile learning easy to use." (M = 5.41, SD = 1.50) and "Learning to operate mobile learning is easy for me." (M = 5.39, SD = 1.47). The lowest scoring item was "My interaction with mobile learning would be clear and understandable." (M = 4.89, SD = 1.50)

Another part of the first objective of the study was to describe undergraduate agricultural education students' behavioral intention in relation to mobile learning (see Table 3). The highest scoring item was "I predict I would use mobile learning in the next 12 months." (M = 5.14, SD = 1.40). The item with the lowest score was "I intend to use mobile learning in the next 12 months." (M = 4.94, SD = 1.57).

Table 1. Descriptive Statistics for Performance Expectancy (N = 303)

Constructs	N	M	SD
Using mobile learning enables me to accomplish tasks more quickly.	303	5.29	1.52
I would find mobile learning useful in school.	303	5.24	1.60
Using mobile learning increases my productivity.	303	4.97	1.49
If I use mobile learning I will increase my chances of getting a good grade.	303	4.74	1.48

Note. Overall M = 5.06, SD = 1.35. Scale: 7=Strongly Agree, 6=Moderately Agree, 5=Somewhat Agree, 4=Neutral (Neither Agree or Disagree), 3=Somewhat Disagree, 2=Moderately Disagree, 1=Strongly Disagree.

Table 2. Descriptive Statistics for Effort Expectancy (N = 303)

Constructs	N	M	SD
I would find mobile learning easy to use.	303	5.41	1.50
Learning to operate mobile learning is easy for me.	303	5.39	1.47
It would be easy for me to become skillful at using mobile learning.	303	5.34	1.49
My interaction with mobile learning would be clear and understandable.	303	4.89	1.50

Note. Overall M = 5.24, SD = 1.37. Scale: 7 = Strongly Agree, 6 = Moderately Agree, 5 = Somewhat Agree, 4 = Neutral (Neither Agree or Disagree), 3 = Somewhat Disagree, 2 = Moderately Disagree, 1 = Strongly Disagree.

Table 3. Descriptive Statistics for Behavioral Intention (N = 303)

Constructs	N	M	SD
I predict I would use mobile learning in the next 12 months.	303	5.14	1.40
I plan to use mobile learning in the next 12 months.	303	5.02	1.56
I intend to use mobile learning in the next 12 months.	303	4.94	1.57

Note. Overall M = 5.02, SD = 1.52. Scale: 7 = Strongly Agree, 6 = Moderately Agree, 5 = Somewhat Agree, 4 = Neutral (Neither Agree or Disagree), 3 = Somewhat Disagree, 2 = Moderately Disagree, 1 = Strongly Disagree.

The second objective of the study was to describe undergraduate agricultural education students' self-efficacy in relation to mobile learning (see Table 4). The highest scoring items were "How much can you do with mobile learning to learn effectively?" (M = 6.01, SD = 1.72) and "How much does mobile learning help you to follow course objectives?" (M = 5.84, SD = 2.00). The items with the lowest scores were "How much does mobile learning get you to believe you can do well in school?" (M = 4.98, SD = 1.90) and "How much does mobile learning help you value learning?" (M = 4.84, SD = 1.87).

Table 4. Descriptive Statistics for Self-Efficacy (N = 301)

Constructs	N	M	SD
How much can you do with mobile learning to learn effectively?	302	6.01	1.72
How much does mobile learning help you to follow course objectives?	301	5.84	2.00
How much does mobile learning help you focus on educational content?	302	5.34	2.04
How much does mobile learning help you assist your peers with educational content?	301	5.32	2.06
How much does mobile learning motivate you to learn educational content?	301	5.19	1.89
How much does mobile learning help you use evaluation strategies?	301	5.19	2.06
Does mobile learning help you evaluate your own learning?	301	5.13	1.97
How much does mobile learning get you to believe you can do well in school?	301	4.98	1.90
How much does mobile learning help you value learning?	301	4.84	1.87

Note. Overall M = 5.31, SD = 1.66. Scale: 9 = A Great Deal, 7 = Quite a Bit, 5 = Some Influence, 3 = Very Little, 1 = Nothing.

Discussion

The results of this study are limited to the population of undergraduate agricultural education students at Texas A&M University. The findings provide a description of factors in undergraduate agricultural education students' behavioral intention towards mobile learning acceptance.

The findings of this study support the application of UTAUT (Venkatesh et al., 2003) and self-efficacy as defined by Bandura (1993), as presented by the researchers. Bandura (1993) defined self-efficacy as the willingness of an individual to participate in new tasks, with high-efficacy individuals seeking new tasks and low efficacy individuals avoiding the same tasks. Venkatesh et al. (2003) UTAUT provided an explanation

for users' behavioral intentions towards an information system. The resulting scores for the areas of performance expectancy, effort expectancy, and self-efficacy were consistent with the theoretical framework.

Students' scores on the performance expectancy construct were compatible with the area of performance expectancy in UTAUT. Venkatesh et al. (2003) suggested performance expectancy measured the users' level of belief in possible gains from using an information system. Students' belief that mobile learning would lead to decreased time allotted to certain tasks supported the idea of an expected performance increase from the use of mobile learning.

The idea of effort expectancy from UTAUT aligned with students' scores on this construct. Effort expectancy is the level of ease a user perceives with the use of an information system (Venkatesh et al., 2003). The students' scores on the effort expectancy construct were congruent with lower expected effort in regards to using mobile learning.

Students' scores on the behavioral intention construct supported the concept of behavioral intention in UTAUT. Venkatesh et al. (2003) defined behavioral intention as an individual's intent to actually use an information system.

The scores from the self-efficacy construct were aligned with Social Cognitive Theory. An individual's self-efficacy is their willingness to take on a particular task (Bandura, 1993). Students' scores on the construct corresponded with students' desires to tackle the tasks of mobile learning. Higher self-efficacy scores indicate a greater level of intent towards new and challenging tasks. Students with higher self-efficacy scores felt mobile learning was a novel and stimulating challenge.

Summary

Future research should address the effect of performance expectancy, effort expectancy and self-efficacy on mobile learning acceptance. Researchers should investigate the relationship between performance expectancy, effort expectancy and self-efficacy and the behavioral intention to accept mobile learning. Studies should be designed examine if increases in performance expectancy, effort expectancy and self-efficacy lead to an increase in behavioral intention toward mobile learning acceptance. The increasing presence of mobile learning in education means instructors will need to understand the effects of performance expectancy, effort expectancy and self-efficacy on students' acceptance of the technology.

Instructors should emphasize the importance of performance expectancy, effort expectancy and self-efficacy in future instructional practice to increase student

acceptance of mobile learning. Agricultural instructors should enhance students' performance expectancy, effort expectancy, self-efficacy and behavioral intention in order to achieve mobile learning acceptance.

Instructors should highlight the mobile learning benefits for student performance in order to address performance expectancy. The performance benefit of mobile learning should be demonstrated through the flexibility mobile learning offers students to complete class related tasks. The ability of mobile learning to access information and assignments to improve educational outcomes without the restrictions of location or time should also be demonstrated to students. Instructors should demonstrate the various academic uses of mobile technology, like conducting research and turning in assignments, to students in order to raise performance expectancy for mobile learning. Instructors could use mobile learning-based assessment and evaluation tools to measure educational goals and objectives. The practical use of mobile learning should enhance student engagement and lead students to realize the benefit of using the technology to improve the achievement of their learning objectives.

The effort needed to adapt to mobile learning should be reduced to better engage effort expectancy. Instructors should present the reduced effort of mobile learning by relating mobile learning back to students' current utilization of mobile technology. An instructor can integrate students' mobile devices into classroom activities and assignments. Students may view mobile learning as a task requiring the same amount of effort as their everyday use of mobile technology. Instructors should use active training to demonstrate the minimal effort needed to use mobile learning. The technology should be incorporated into instructional design processes to decrease the effort needed for students to get involved with mobile learning.

Students' self-efficacy skills should be increased so their willingness to participate in a new and possibly challenging task like mobile learning is increased. Students' self-efficacy could be increased by reducing the degree of difficulty associated with mobile learning. Students' current usage of mobile technology should be paired with the idea mobile learning. Mobile learning should be demonstrated as an extension of students' current mobile technology use to reduce their perception of mobile learning being a difficult task. Students willing to engage in mobile learning will be more likely to appreciate the process as a positive part of their educational growth. Instructors giving attention to students' performance expectancy, effort expectancy and self-efficacy, may lead to students' greater behavioral intention to adopt mobile learning.

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Factors that Influence Student Decisions to Enroll in a College of Agriculture and Life Sciences

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Abstract

Students in an introductory College of Agriculture and Life Sciences course were surveyed to identify the most important factors influencing their decisions to enroll in the College of Agriculture and Life Sciences at Texas A&M University. Eighty percent (N = 581) responded to an online survey. While parents were reported by 18.1% of the respondents as being the most influential person regarding choice of major, university Internet resources and agricultural related hobbies were also reported as influential. Scholarships and high school visits from university representatives were reported as the least influential recruitment tool. Over one-third of students reported no agricultural work experience during high school, and athletics was the most common high school activity in which students participated. As the population changes and our society becomes further removed from production agriculture, perhaps it is time to revisit strategies we use to attract non-agriculture students to colleges of agriculture.

Introduction

Student recruitment is a critical concern of university faculty and administrators in the field of agriculture. This is especially true at a time when the need for employees across various agricultural disciplines continues to expand. While studies have been conducted regarding the recruitment and retention of students into high school agricultural science programs (Bell and Fritz, 1994; Dyer and Breja, 2003; Reis and Kahler, 1997; Rossetti et al., 1990; Sutphin and Newsom-Stewart, 1995), the recruitment of individuals to teach agricultural science (Lawver and Torres, 2011; Park and Rudd, 2005) and the recruitment of individuals to work within Extension (Arnold and Place, 2010), only limited research has

addressed recruitment and retention of students to major in agriculture at the university level.

When looking at recruitment and retention of students in agriculture related to the college/university setting, findings have varied. As shared in the literature, students decide to attend a college/university after high school for a wide variety of reasons. Parents have been identified as an influencing factor on children, both in college (Reis and Kahler, 1997; Rocca and Washburn, 2005; Wildman and Torres, 2001) and prior to college, when children choose to participate in youth organizations (Maurer and Bokemeier, 1984). Further, Rocca and Washburn (2005) reported that the “connection between majors and professional career tracks” (p. 36) is needed in recruitment efforts. Dyer et al. (2002) reported that “prior experience in agriculture and enrollment in high school agriculture programs” (p. 3) were the strongest predictors of student retention in colleges of agriculture. However, a 2010 study of Missouri FFA students found that “enrollment in secondary agriculture did not consistently produce greater academic performance in college,” and that “there was no conclusive relationship found between level of involvement in secondary agriculture and academic performance [grade point average] or retention in college” (Smith et al., 2010, p. 24).

A study conducted by Wildman and Torres (2001) served as the conceptual basis for this research. Wildman and Torres (2001) studied the influence of five factors on a student’s selection of an agricultural major. These factors included: “1) exposure to agriculture, 2) family and friends, 3) college of agriculture recruitment activities, 4) professionals and 5) job considerations” (p. 48). The results of this study revealed that the most influential factor was “prior experience in agriculture”

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(p. 54). Additional findings revealed that the atmosphere of the departments within the college also influenced students' decisions and that the individuals most likely to influence a student's decision of what to major in included professionals within agriculture and "personal role models" (p. 54). The opportunity to work in the outdoors was also indicated as an influence.

The purpose of this study was to gain insight into students' decisions to enroll in the College of Agriculture and Life Sciences at Texas A&M University. Specific research objectives included:

1. Identify recruitment materials influencing students' choice of college major.
2. Identify individuals who were influential in choices of college major.
3. Identify recruitment experiences influencing students' choice of college major.
4. Identify career-related experiences influencing students' choice of college major.

Methods

To determine the factors influencing enrollment of College of Agriculture and Life Sciences students at Texas A&M University, the researchers used an adaptation of Williams et al. (2007) survey of incoming students. Wildman's (1997) "Factors in High School that Influence Choice of Major in College" was used as the basis for Williams et al. (2007) study. The instrument was divided into three sections. Section one evaluated external factors of influence upon selection of academic major, section two recorded student characteristics and background information and section three captured demographic information. Wildman (1997) reported test-retest reliability of 75% to 100% *a priori* for the first two sections of the instrument. The adapted instrument was reviewed for content validity by a panel of university professors and no changes were made to the instrument.

The target population for this census study was all students enrolled in the course entitled "Introduction to College of Agriculture and Life Sciences," during the fall 2009 and spring 2010 semesters (N=725). Students were notified in class that they would be receiving an invitation to participate in the survey. The students were informed, per Institutional Review Board protocol number 2009-0619, that their participation in this study was voluntary. The list of e-mail addresses of students enrolled in the course was provided by the course instructor. The initial survey link was sent to the students via e-mail. The instrument was administered via the online survey engine, SurveyMonkey®. Students were

sent three reminders, one after seven days, 14 days and 21 days. Dillman (2000) suggested that four contacts are sufficient when conducting electronic surveys. The number of usable responses from the online instrument was 581 yielding an 80% response rate.

The population for this study consisted of 65% (n=367) female students and 35% (n=198) male students. The respondents' ages ranged from 17 years of age to 48 years of age at the time they responded to the questionnaire. A majority of the students, 62.9%, were born after 1989 while only 4.3% were born before 1987. More than 90% of the students were from Texas, and of the other 5.7%, only two of them were from outside the United States. Nearly 65% (n=368) of the students entered Texas A&M University as a full time student with college credit already accrued. Slightly less than two-thirds (n=375) of the students stated that they had been enrolled in a high school agricultural science program and almost 60% (n=330) of the responding students reported that their immediate family is not involved in agriculture or life sciences.

Results

The influence from individuals and professionals on the respondents' decisions to major in the College of Agriculture and Life Sciences is summarized in Table 1. The person who participants identified as having the most influence was a parent or guardian (18.1%, n=105). Following closely behind were relatives in an agriculture or life sciences related field of work (15.5%, n=90), and their personal role model (15.1%, n=88). On the opposite end of the spectrum, 59.9% (n=348) of the participants in the study reported that their high school principal or administrator was not influential in their decision to major in agriculture or life sciences.

Table 1. Reported Influence by Individuals on Students' Decisions to Major in the College of Agriculture and Life Sciences (N= 581)

	Not Influential		Very Influential	
	%	f	%	f
Parent or guardian	11.2%	65	18.1%	105
Relatives in an agricultural & life sciences field of work	20.5%	119	15.5%	90
Sister or brother	40.8%	237	4.8%	28
Other relatives	27.9%	162	7.6%	44
Friend in high school	33.0%	192	4.1%	24
Friend in college	26.7%	155	7.1%	41
Personal role model	20.8%	121	15.1%	88
High school science teacher (biology, chemistry, earth science)	31.0%	180	7.7%	45
Extension professional (4-H agent or 4-H leader)	52.2%	303	7.2%	42
High school counselor	48.7%	283	1.4%	8
High school agriculture science teacher	47.0%	273	13.4%	78
High school principal or administrator	59.9%	348	0.9%	5
Other high school teacher(s) (history, math, English etc.)	47.3%	275	1.4%	8
Alumni from the college of agriculture & life sciences	36.5%	212	7.1%	41
Any other professionals	55.4%	322	11.0%	64

Note. Scale: 1 to 10, 1= factor was not influential, 10= factor was very influential. Respondents could report a number between 1 and 10. Only respondents that reported 1 (not influential) or 10 (very influential) are reported here. f= Frequency of response.

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Recruitment material was not reported as frequently to be influential in students' decisions regarding college choice. Table 2 reports the frequencies and percentages of students who identified recruitment materials as being influential in their decision to major in the College of Agriculture and Life Sciences. The recruitment material that the students listed as the least influential included departmental scholarships and other financial incentives. Of the students who responded to this question, 50.4% (n=293) listed scholarships as not influential, while only 5.2% (n=30) felt that scholarships from a department were very influential in their decision to major in the College of Agriculture and Life Sciences. On the opposite

end of the spectrum, the participants ranked Texas A&M University Internet sources about their major as the most influential recruiting material with 12.7% (n=74) responding that it was very influential. However, the number of respondents who listed Internet sources as not influential was still greater at 14.5% (n=84). The lowest influence of all the recruitment material was granted to radio broadcasts about agriculture and life sciences (n=2) and non-technical magazines about agriculture and life sciences (n=5). Less than 1% of the respondents in each of these categories listed these items as very influential in their decision to major in the College of Agriculture and Life Sciences.

Table 2. Recruitment Materials Reported as Influencing Students' Decisions to Major in the College of Agriculture and Life Sciences (N= 581)

	Not Influential		Very Influential	
	%	f	%	f
Internet sources about agriculture & life sciences	18.2%	106	4.3%	25
TV programs about agriculture & life sciences	20.8%	121	1.7%	10
Newspaper articles about agriculture & life sciences	25.0%	145	1.4%	8
Radio broadcasts about agriculture & life sciences	38.7%	225	0.3%	2
Non-technical magazines about agriculture & life sciences (Time, US News, Newsweek, etc.)	32.0%	186	0.9%	5
Technical journals focused on agriculture & life sciences (Journal of Wildlife Management, Journal of Animal Science, etc.)	36.8%	214	1.4%	8
Scholarship(s) from student's department	50.4%	293	5.2%	30
Other financial incentives	47.3%	275	5.9%	34
Informational pamphlets about student's major	20.1%	117	5.9%	34
Texas A&M University Internet sources about your major	14.5%	84	12.7%	74
Advertisements about the College of Agriculture and Life Sciences	27.7%	161	5.3%	31

Note. Scale: 1 to 10, 1= factor was not influential, 10= factor was very influential. Respondents could report a number between 1 and 10. Only respondents that reported 1 (not influential) or 10 (very influential) are reported here. f= Frequency of response.

Table 3. Recruitment Experiences that May Have Influenced Students' Decisions to Major in the College of Agriculture and Life Sciences (N= 581)

	Not Influential		Very Influential	
	%	f	%	f
Agricultural science courses in high school	23.1%	134	16.7%	97
Personal work in an agricultural & life sciences related field of work	21.0%	122	24.4%	142
Agriculture & life sciences related clubs or organizations	22.4%	130	20.7%	120
Agriculture & life sciences related hobbies	11.2%	65	27.5%	160
4-H or FFA leadership development events	42.7%	248	21.9%	127
4-H or FFA livestock shows, horse shows, or rodeos	39.6%	230	23.8%	138
4-H or FFA judging or career development events	45.3%	263	18.4%	107
Personal visit with a representative from Texas A&M University College of Agriculture & Life Sciences	25.1%	146	11.5%	67
Faculty's friendliness in student's department	11.2%	65	21.3%	124
High school visits from Texas A&M University College of Agriculture & Life Sciences representatives	48.4%	281	5.3%	31
Friendly atmosphere in College of Agriculture & Life Sciences	8.3%	48	21.9%	127
Teaching reputation of agricultural professors	16.4%	95	17.6%	102
Teaching reputation of student's departmental & major professors	16.2%	94	16.9%	98
Agricultural related clubs/activities	25.0%	145	9.3%	54
Activities on the Texas A&M University campus	25.0%	145	6.9%	40
Any other agricultural and life sciences experience(s)	18.2%	106	21.0%	122
Any other factors that influenced selection of current major	55.8%	324	5.7%	33

Note. Scale: 1 to 10, 1= factor was not influential, 10= factor was very influential. Respondents could report a number between 1 and 10. Only respondents that reported 1 (not influential) or 10 (very influential) are reported here. f= Frequency of response.

Influence regarding the selection of a major in the College of Agriculture and Life Sciences based on recruitment experiences encountered by the participants in this study is presented in Table 3. Almost half (48.4%, n=281) of the respondents listed high school visits from Texas A&M University College of Agriculture and Life Sciences representatives as not influential; while 4-H or FFA career development events came in with 45.3% of the students reporting that participation in these events was also not influential in their decision to major in the College of Agriculture and Life Sciences. Of the recruitment experiences listed, agriculture and life sciences hobbies were described as being very influential by 27.5% (n=160) of the participants. Personal work in an agricultural and life sciences related field was also more frequently reported as very influential (24.4%, n=142).

Career, professional and work related factors that students considered when selecting a major within the College of Agriculture and Life Sciences are reported in Table 4. The factor that most students gave no consideration to was the opportunity to work with plants (40%, n=228). The students showed much more consistency in the high consideration column, with six of the 10 categories given high consideration by at least 20% of the respondents. These categories included income gained after college, future job market of the career, working with animals, working with people, field (out-of-office) work and working outdoors. The highest consideration reported was the ability to work with people, which was indicated by 28.9% (n=165) of the respondents.

A compilation of work experience in agricultural or life sciences areas reported by current students majoring in agriculture and life sciences is reported in Table 5 using percentages

Table 4. Career, Professional, and Work Related Factors Considered by Students when Selecting a Major within the College of Agriculture and Life Sciences (N= 581)

	No Consideration		High Consideration	
	%	f	%	f
Prestige of career	6.8%	39	15.6%	89
Income gained after college	3.7%	21	20.4%	116
Future job market of career	2.5%	14	23.9%	136
Location of career	6.8%	39	17.9%	102
Working with animals	23.0%	131	25.3%	144
Working with plants	40.0%	228	3.5%	20
Working with people	3.2%	18	28.9%	165
Field (out-of-office) work	9.6%	55	27.9%	159
Working outdoors?	14.6%	83	25.4%	145
Any other considerations?	37.4%	213	13.2%	75

Note. Scale: 1 to 10, 1= factor was not influential, 10= factor was very influential.
 Respondents could report a number between 1 and 10. Only respondents that reported 1 (not influential) or 10 (very influential) are reported here.
 f= Frequency of response.

Table 5. Students' Agricultural Work Experiences Before Graduating from High School (N= 581)

	%	f
No agricultural work experience	36.7%	209
Food processing	6.8%	39
Horticulture	8.8%	50
Work for a veterinarian	14.9%	85
Work on family farm or ranch	38.6%	220
Work on other farm or ranch	28.2%	161
Forestry-related	2.3%	13
Extension service	5.1%	29
Wildlife management	10.9%	62
Golf course	5.6%	32
Agricultural biology experience	4.9%	28
Landscaping business	10.4%	59
Other agricultural experience	24.2%	138

Table 6. Activities that Students Participated in During High School (N= 581)

	%	f
No high school activities	1.8%	10
Student council or student government	38.6%	220
Cheerleading or spirit squad	13.3%	76
School newspaper or yearbook	11.4%	65
Athletics	70.5%	402
School electives (debate, drama, band, chorus, etc.)	44.4%	253
Hobby clubs (chess, photography, etc.)	16.8%	96
FFA	30.9%	176
Other vocational student organizations (i.e., FCCLA, DECA)	20.2%	115
School subject clubs (i.e., science club, math club)	25.4%	145
National honor society	61.9%	353
4-H	18.1%	103
Other high school activity	36.5%	208

and frequencies. Of the responding participants, 38.6% (n=220) reported having had work experience on the family farm or ranch. About the same amount of participants, 36.7% (n=209), reported no agricultural work experience prior to graduating from high school. Forestry-related work experience received the least amount of responses with only 2.3% (n=13) of the students reporting to have worked in this industry before they graduated from high school.

Frequencies and percentages of the activities that respondents participated in during high school are presented in Table 6. Only a few respondents (1.8%,

n=10) stated that they did not participate in any high school activities. Highest levels of participation were reported in athletics (70.5%, n=402), and the national honor society (61.9%, n=353). FFA was reported as a high school activity by 30.9% (n=176) of the respondents, while 4-H was listed by 18.1% (n=103) of the respondents.

Discussion

Prior research (Reis and Kahler, 1997; Rocca and Washburn, 2005; Wildman and Torres, 2001) indicated that parents are influential in regard to students' choice of major; however, while this study supported that previous research in that 18.1% of students reported parents as being very influential, it is critical to note that the percentage is not as high as one might have thought. In addition, siblings, other relatives and high school friends were not reported to be influential in regard to choice of major. Based on these findings, it was concluded that influence of family and friends on choice of major may be changing as the generation changes.

Results from this study revealed that there are components of secondary agricultural education that do not significantly influence student enrollment in the College of Agriculture and Life Sciences. Unlike a previous study finding (Dyer et al., 2002), data revealed that previous agricultural science courses in high school did not influence the study respondents' decision to enroll in a college of agriculture. Similarly, participation in agriculture and life sciences related clubs or organizations did not appear to influence respondents' enrollment in a college of agriculture and life sciences.

In regards to potential career based factors, the data collected revealed that the highest percentage of the students reported "working with people" as being highly considered when choosing a major within the College of Agriculture and Life Sciences. However, factors including "working with plants" and "working with animals" were reported more frequently by the respondents as not considered. Conversely, the ability to work "outside of an office" and a potential career "working outdoors" were both frequently reported as a high consideration when choosing a major within the college. These findings are similar to those reported by Reis and Kahler (1997) in regard to participation in high school agricultural science programs.

A considerable number of the respondents had work experiences in various agricultural and life sciences fields prior to graduation from high school. The work experience reported most often was working on the family farm or ranch, with 38.6% (n=220) of the respondents reporting that they had held a position of this nature. Based on these findings, it was concluded

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that of the students who had held jobs in agriculture and life sciences related fields before graduating from high school, the majority of these jobs were on farms and ranches. However, more than one third, 36.7% (n=209), of the respondents reported that they had no work experience in an agriculture or life sciences related field. This differs from Wildman and Torres (2001), who reported that “prior experience” (p. 54) in agriculture was the most influential factor in choice of major.

Athletics was reported as the most popular high school activity for responding students, with over 70% (n=402) reporting that they participated in athletics. A slightly less amount, 61.9% (n=353), reported that they participated in national honor society in high school. The two most common agriculture and life sciences related clubs (i.e., FFA and 4-H) showed moderate to low participation from the students in this study. Based on these findings, it was concluded that students who major in the College of Agriculture and Life Sciences may not necessarily come to the classroom with extensive agricultural experiences or agricultural training.

Recommendations and Implications

Students interact and relate to technology on a regular basis; thus, it is not surprising that the Internet was reported as one of the more influential forms of communication. The traditional means of recruiting students to a college of agriculture must be revisited. Students who have interests and abilities in science and math but are perhaps not a part of a secondary agricultural education program must be made aware of opportunities within the field of agriculture so that the need for human capital in this area can be met. Past studies conducted by Dyer et al. (1999) and Washburn et al. (2002) reported high school agriculture teachers to have demonstrated the most influence on students entering colleges of agriculture. The results of the current study do not support those findings. The study reported here found that several components of secondary agricultural education programs, in addition to high school agriculture teachers, do not influence a student’s decision to enroll in the College of Agriculture and Life Sciences.

The millennial generation has characteristics and interests that are different than previous generations. Colleges of agriculture should invest more time and effort into recruiting this diverse and often misunderstood generation of students and begin developing new recruitment strategies for future students. Given that findings from this study found that significant persons and communication efforts are not highly influential, perhaps instead of Chapman’s Model of Student Choice, recruitment efforts should focus on using apps, Twitter™,

Facebook™ and other social media to effectively reach clientele that includes students from varied (i.e., non-agricultural) educational backgrounds.

Implications stemming from this study are largely directed at recruitment efforts currently being used by colleges of agriculture. Having students visit a college campus for any type of event has always been viewed as a prime opportunity to recruit for the university and the college hosting the event. If indeed 4-H and FFA events are not influencing nearly half of the students in the study to choose a major in the College of Agriculture and Life Sciences, consideration should be given to how funds for recruitment are spent.

Colleges of agriculture have typically enrolled a high percentage of students with some agricultural background, often with 4-H or FFA influences. While the authors are not recommending that administration abandon efforts to recruit students who are active in agricultural youth organizations in high school, it is critical that additional populations receive recruitment attention. As the population changes and as our society becomes further removed from production agriculture, perhaps it is time to revisit strategies to attract non-agriculture students to colleges of agriculture.

There are several recommendations for practice and future research. Colleges of agriculture should explore all means of social media (e.g., apps, Twitter™, Facebook™) to determine the most effective means of communicating with today’s potential students. Recruitment efforts should be focused on reaching an increasingly diverse and non-agricultural pool of potential students while continuing to develop recruitment materials and media that will resonate with parents/guardians and other relatives.

This study represents the viewpoint of the 80% of students who voluntarily completed the online survey and thus there is the potential for bias. Future research should investigate the use of social media on college of agriculture student recruitment. Comparing students with agricultural backgrounds (e.g., 4-H/FFA members) to students with no agricultural background to determine differences in recruitment strategies as well as whether or not actual visits to campus (e.g., 4-H/FFA events, campus tours, summer workshops) lead to enrollment in a college of agriculture. The determination of the relationship between selection of college major and career goals reported by agriculture students could provide additional insight into this line of inquiry.

Summary

A total of 581 students reported parents and guardians were the most influential people in students’ decisions to enroll in a major within the College of Agriculture and

Life Sciences. The Internet was indicated as the most influential recruitment source and “agriculture and life sciences related hobbies” were reported most frequently as an influence on respondents’ decision to major in the College of Agriculture and Life Sciences. “Working with people” was reported as the leading career, professional and work related factor in choosing a major in the College of Agriculture and Life Sciences. These factors, along with many others, require further investigation to enhance recruitment efforts in colleges of agriculture.

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March 1983

Student Motivation

David L. Kittrell and
Gary E. Moore

Imagine you have the opportunity to observe two professors as they start teaching a unit on engine operating principles. Professor X comes into the classroom and says, "Today I'm going to teach you about the internal combustion engine. The internal combustion engine generates power by utilizing the force created by burning a fuel and air mixture. This force is confined to a cylinder. The expanding gasses force the piston downward in the cylinder and turn a crank that powers the drive train." Professor X continues to give an explanation in this manner for the rest of the class period.

In a neighboring college, Professor Y drives a small gasoline powered garden tractor into the classroom as the period begins. The tractor engine is obviously not hitting on every cycle and is emitting a dark blue smoke from the exhaust pipe. The professor turns off the engine and gets off the tractor as class begins. Professor Y begins class in this manner, "This is my neighbor's tractor and the engine obviously needs some attention. Our job will be to identify the problems in each of the four systems of this type of internal combustion engine and repair the engine. After we complete this process, we will develop a routine maintenance list for my neighbor to use to help avoid future down-time. Let's begin today by studying this type of

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engine and try to understand the four systems that work together to make it run." Professor Y then asks what are the systems within the engine that work together to produce needed power. He records student discussion about the systems of the internal combustion engine on the chalk board and discusses each for the remainder of the period.

If you were one of the students, which class would you prefer to be in? Undoubtedly you want to be taught by Professor Y instead of Professor X. You would probably learn more about engines and remember it longer. Students in Professor X's class will soon be looking out the window, writing notes to others, sleeping, or causing discipline problems. The primary difference in the two classes was Professor Y's attempt to motivate the students to learn. The ability to motivate students is a skill that can be learned but requires thought, effort, and planning. However, the improved interest in class and increased learning on the part of the students is well worth the effort.

Concise But True

Land grant colleges and universities are knowledge centers that integrate the three functions of teaching, research, and service. They should gleam with a different light from the earlier tradition centered institutions because of their common man philosophy developed by the Morrill Act. This act was based on a philosophy of practicability and democracy. This philosophy was intended to save these institutions from self-serving and elitist pursuits and focus on needs of the people (Vines and Anderson, 1976). Most of the non-land grant universities with agriculture programs abide by the same philosophy.

Instruction at these institutions should also reflect the practicability and democracy philosophy. However, often the information giving approach is taken without adding the practicability that was intended in the earlier legislation. Our responsibility is not only to provide information but to cause learning (Brown, 1981). This statement is concise, but true. Both Professor X and Y in the introductory example would accomplish the responsibility of providing information. Yet, Professor Y's procedure would best reflect the Morrill Act philosophy.

Incorporating The Philosophy

A common assumption of many college instructors is that students are internally motivated to learn. These students, especially those in agriculture, usually have a handy set of experiences in their background that allow the generalization of information presented in class. Yet, seldom do students have the same set of classroom experiences and need to be helped in generalizing the information. We, as instructors, need to take some responsibility in getting our students motivated or prepared to learn. The old saying "You can lead a horse

to water but can't make him drink" is an excuse many university professors use to rationalize their uninspiring teaching performance. However, we know that if you give the horse plenty of salt first, he will probably drink. Our challenge then is to salt our students so they will be thirsty for our teaching.

The process of preparing students to learn is identified by different names including the term motivation. Other names for motivating students include: **establishing set**, **establishing learning set** and **learning readiness**. A more recent term being used in education is **advance organizer**. In some educational circles the synonymous terms are **developing interest** or **interest approach**. Technically, there are differences in these terms but all relate directly to motivation. So to simplify terms, the definition of motivation as it relates to teaching is **something which causes a student to learn**.

Motivational strategies help the student generalize or apply the information given in the class. Many psychologists argue that one person cannot motivate another, but experience has told teachers that one can make the students want to learn. Even dry course material can be made interesting with the incorporation of motivational strategies.

Self Evaluation

How many of these types of motivational strategies do you use in your classes? Below is a list of some of these strategies for your use in evaluating your motivational effectiveness. Review this list of tried strategies and evaluate yourself and your classes.

Get to know your students. Try to understand their expectations for the course, interest in the subject, career goals, family background, and peer pressure. If you know about your students' background you can then relate your teaching to their background.

Arouse a feeling of need in students. Relate the course material to real life situations and uses. Explain how mastering the course content will improve operating efficiency, increase farm income, and save money.

Explain your expectations. Explain to the students what they need to learn. Don't play hide and seek. Let your students know what is important to learn. It is difficult to motivate students to learn if they don't know what they are to learn.

Be enthusiastic. Prepare yourself mentally for each class session. The class tone will be set by your enthusiasm and attitude. If you are not enthusiastic about what you are teaching, how can you expect your students to be enthusiastic.

Use illustrations and personal examples. Relate materials to experiences you have had. Have students relate their experiences.

Use visuals, realia, actual objects, and demonstrations. Students remember more of what they see and do versus what they only hear.

Use problem solving. Create or locate problems to solve. This encourages higher level learning and keeps students thinking about the subject of study. If students can see how the information they are being taught can be applied, they will be more willing to learn.

Involve students. There is nothing wrong with asking students questions as you teach. This helps keep students alert in anticipation of being asked a question and also causes them to think.

Be organized. Organize your course into instructional units and daily lessons so students can see a logical, organized process. It is much easier for students to learn if the teacher is organized.

Provide a satisfactory environment. Create a good physical learning environment and minimize distractions.

Use competition. Simple competition like the old spelling bee can increase class participation and study.

Use curiosity and suspense. Leave out key words on transparencies and ask for student completion. Bring a sack of realia to class on the topic of discussion and at different times in the class period reach in and bring out items for discussion.

Gimmicks and the novel are interesting. Use games, panels, or novel ideas in class for a change of pace.

Provide positive reinforcement. Verbally reward a job well done. A pat on the back will make students work even harder.

Use humor. Tell occasional jokes or show cartoons that relate to the subject of study. They lighten the class atmosphere, but maintain the student's thought on the subject.

Use pretests. Pretests or daily extra point quizzes alert students to key points.

Use a variety of techniques. Mix up techniques like slide sets, demonstrations, small group discussions, and laboratory projects to make class interesting. Even the most exciting teaching technique gets old after a while if it is the only one used.

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What Are We Doing Right?

Are you tired every morning? During the work day, do you feel like a ton of bricks are upon your shoulders? Have you felt like you could not relax in some time? Is about all you think about, lately, is work? Well, we suspect that you are not alone (Dodson, 2006). The pressure to produce in academia is huge! Whether it is the graduate student/scholar level to the full-professor level, we are expected to go “above and beyond” to be the best (Dodson, 2008). The best in research, teaching/learning, advising and service are becoming the norm, not the exception these days. Yes, the best, even in light of increasing numbers of roadblocks.

Limitations to our success include reduced numbers of grant dollars available for a higher number of competing grant proposals submitted (Dodson, 2006b). How might one obtain grant funding when there is (absolutely) no program in which to submit a proposal? Moreover, if one submits a grant proposal to a level-funded program whereby 200 proposals are vying for five (funded) projects, it is difficult to expect to receive support. In parallel to this, we are expected to perform in an outstanding manner in the classroom even if resources are not available for purchase of media supplies, etc (Dodson et al., 2006c). Personal advising of students seems to be something of the past and “professional advisors” are now taking over advising duties in departments all over the country, which limit faculty contact with (especially) undergraduate students. Centralization of services sometimes leaves the main office of some department’s void of any personnel (at times) such that students come for help, and no one is there. While times are changing and the new face of academia means less funding to teachers (even in light of increased costs to students; Dodson, 2011), limited desire to/tools with which to teach, detached (from the faculty) advising and empty spaces in our (once thriving) main offices, are there things that we are doing right?

Dedicated academicians have sized up the changing environment to which we (all) are being channeled into and have (in many cases) chosen a strategy for their work that focuses on what they feel is important. Can research be conducted without an abundance of funding? Sure, and the idea that research teams [perhaps at the international level] may be formed

to share what little everyone has to contribute effectively to a scientific field (Dodson et al., 2010b). Teachers are learning how to teach with no one “watching their back.” Indeed, one-on-one instruction is not only vogue, but an effective way for not only deciphering the intent of students, but to see who has the “spark” for learning (Duris et al., 2012). Moreover, classrooms (whether plugged in or not; Dodson, 2007) produce a student product that can compete nationally for jobs, professional school or graduate school (Dodson and Benson 2010). This leaves service. What can one say? If a department has been decimated to the point whereby the main office is ran by work study students, something is wrong. Administrators will need to take a look at this and determine the solution. The days of individualized student contact (by all faculty members) seems to be over.

In light of our changing academic climate, it is naturally difficult for a participant to get up (each morning) and head for school. Yet, we keep doing it. That is the astounding part of all of this. Even with all of the stress and more will come each day, dedicated academics keep working and imparting as much wisdom to the people around them as possible. Does it take a toll to “stamp out ignorance” and to motivate students? Sure, but teachers know how to do things right....and will continue to do so.

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What Does the Public Think of Agriculture?

According to the US Department of Agriculture, there are over 285,000,000 people living in the United States. Of that population, less than 1% claim farming as an occupation (and about 2% actually live on farms). There are only about 960,000 persons claiming farming as their principal occupation and a similar number of farmers claiming some other principal occupation.

Agriculture students at Wright State University Lake Campus enrolled in a class “Ag Society” are learning about trends and issues in agriculture. As part of their curriculum, Dr. Greg Homan, worked with them to develop and administer a survey of local residents to explore local perceptions of agriculture. Students visited local restaurants and stores to discuss agriculture with a random sample of local residents in St. Marys, Celina and Coldwater.

When residents were asked what they thought of farmers, their replies were varied, but positive. One respondent replied “Farmers are good, hard-working people.” Another individual commented, “They work very hard to feed the country and help the economy a lot.”

When ranking the impact of four possible impacts on their food buying choices, the averages in order of predominance of response were: 1) Nutrition, 2) Taste, 3) How it was Produced and 4) Cost. When asked how their food buying/consumption was different from their parents, most respondents indicated they were purchasing more of their food (versus raising it), were selecting more convenience items (packaged/prepared

foods) and had a much wider variety of items to select from than their parents.

Consumers were asked “*Your food price includes a variety of costs such as processing, shipping, marketing, etc. How much of every \$1 spent on food in the United States do you think goes to the farmer that produces it?*” Typical responses ranged from approximately 40-60 cents per food dollar. According to the American Farm Bureau, approximately 16 cents of every food dollar is earned by the farm producer to pay for their labor, supplies, land, etc. The students also explored with respondents how they thought agriculture had changed over the past 100 years. Common perceptions of agriculture change included modernized technology, larger farms and bigger equipment.

When asked about the potential prospect of an increasingly larger share of the United States food being produced in another country and imported to the United States, most respondents weren’t very positive. One respondent commented, “*I don’t trust food produced in another country as much.*” Another participant replied, “*I don’t think their safety is as good (in other countries).*”

According to student, Alyssa Muhlenkamp of Coldwater, “*By surveying people buying groceries about agriculture, I learned that many people feel farming importance has declined and don’t realize everything that goes into it.*” Levi Krouskop of Spencerville replied, “*The area I surveyed surprisingly knew more about agriculture than I expected. I expected uneducated responses but, many of the people were somehow connected to agriculture, knew a great deal about it and respected those involved in it.*”

Submitted by

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Practicing and Preparing for Stakeholder Interviews

Students have found substantial educational value in their interviews with farmers and other stakeholders as an integral component of learning and practice in agroecology. As teachers we need to provide time for planning strategies and practicing the skills of dialogue-based interviews to have students well prepared before meeting farmers and stakeholders in the community. We have found that a three-hour “crash course” learning about and practicing interviewing can be effective for introducing the method in the agroecology context.

Teaching Tips/Notes

Characteristics of the interview method include a mutual appreciation that students are involved to learn, that there is a specific purpose and this is clear to all involved, that the process is open ended and designed to maximize what is derived from interviews and that a dialogue-based interview is superior to a straight-forward set of rigid questions often used in a survey or highly structured questionnaire. Here we summarize learning objectives, learning methods for using interviewing and apparent outcomes for students from this educational and research process.

Learning objectives are to learn about and practice 1) empathetic interviewing with thoughtful concern about the interviewee, 2) careful listening and observing during the interview process and 3) critical reflection by the student team following the actual interview, emphasizing key challenges in the interview process. These three activities correspond to several agroecological key competencies (Lieblein et al., 2012).

Learning methods used to accomplish these objectives and to acquire such practice include dividing students into groups of three to conduct a role-play exercise. One student does the interview, a second is the stakeholder interviewed and a third takes notes as an active observer of the process. The group first chooses a topic for the interview and then develops an interview guide that elaborates a list of research questions that help to narrow and focus the topic which are then transformed into interview questions (Kvale and Brinkmann, 2009). Examples of each are given under outcomes.

One possible schedule for a 90-minute session on learning and practicing interviews is:

Introduction. Fifteen minutes introduction and discussion of importance of techniques and characteristics of the dialogue-based interview; more time may be needed here.

Role-play exercise. Twenty-five minutes with small groups deciding on roles and developing interview guide and 10 minutes to conduct the interview and observe the process.

Reflection. First, in small groups (about 10 minutes), and then whole class reflection and discussion of the process and key challenges of performing dialogue-based interviewing (about 30 minutes).

Times can be adjusted for the nature of the class as well as their prior experience and level of comfort with the process. Investing the majority of available time in preparing the interview guide and reflecting on results demonstrates to students the over-riding importance of planning and reflecting on the process as compared to merely conducting an interview and writing down the results.

Outcomes of the educational process on interviewing

techniques depend on educational context within which the activity will be conducted, the topics chosen and the dedication of students to quickly acquiring the skills to design and conduct such interviews. An example of an interview guide to explore questions on communication may include:

Topic: Communication with stakeholders in the case study region.

Research questions: What methods do farmers use to communicate among themselves? What are strengths and weaknesses of the present communication process?

Interview questions: Can you describe the ways you farmers here currently discuss ideas about farming practices, markets and other key issues related to farming? What do you learn from other farmers and in what ways are these lessons useful? How would you see the communication situation in your region improved?

During the reflection period after this short exercise with an agroecology class in Norway, several comments and questions were raised by the group:

- How to initiate the interview is important, including establishing trust and credibility, clearly stating the purpose of the interview, discussing how the results will be used and describing the move from simple to complex questions.

- There is great importance in designing open-ended questions and to allow the dialogue to move from the initial topic to more in-depth issues related to it.

- One challenge is to decide whether or not to record the interview, realizing that this may create a barrier to communication and that much time is needed later.

- Observations about body language, apparent feelings about specific questions and other details form the bases for reflections on how to improve yourself as an interviewer and add more information to what is written.

- Finish with questions like: “Are there additional topics you would like to discuss?” and “What do you have to add to what we have already discussed?”

Just as agroecosystems are diverse and complex, likewise the stakeholders represent a wide and divergent population. According to action learning (Lieblein and Francis, 2007), students who intend to understand and cope with the complexity of food systems need to be prepared to adapt to the circumstances and dynamic nature of an interview situation. We have found that a “crash course” provides students with experience in a safe space environment before applying this qualitative method in the field.

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The Power of Magnetic Leadership

**By Dianne Durkin, Published by CreateSpace,
\$19.95, 152 pages, ISBN 978-1-4537-5123-7**

The Power of Magnetic Leadership, uses the lessons learned from dozens of successful company leaders to explain how the best leaders engage employees, set the example by showing how to play well with others, and inspire people by demonstrating that every action they take is relevant to them.

The best leaders are people who know how to listen, can make a promise and deliver on that promise, and have stepped up to the plate and made the necessary investment to successfully engage their employees.

The best leaders motivate, inspire and energize people by connecting the vision, values, purpose and business goals of the organization to individual values and needs. Here are some of the top actions she recommends to people seeking to improve their success as a leader.

1. **Develop Your Vision.** Make sure you have a vision with the purpose and values to make it real. State where you are going clearly. State your purpose simply. Express your values – the things that you use to guide every action people take at work – directly.

2. **Identify Your Leader Type** Knowing who you and what type of leader you are helps you and others identify where, when and how to best behave and act to focus their energy to achieve the goals and objectives you set out for them.

3. **Track Your Leadership Development Progress.** Keep a leadership log to document what you do and what happens. Review what happens regularly. Reflect on what you are learning and how you are changing.

4. **Recruit and Retain the Right People.** Identify what makes individuals successful in your culture, and recruit for those skills. The culture will keep them loyal and happy, and exceed all expectations. Improve your interview and listening skills so you can hear what your employees are saying. Document and take immediate action when you identify something that needs to be improved.

5. **Engage, Empower and Enrich Your Employees.** Invite employees to become part of your vision. Empower them to be a force of change and be enriched by your culture. Make your employees part of the solutions, by giving them a role and the responsibility for implementing solutions to major business issues.

6. **Create a Work Environment that Fosters Creativity and Innovation.** Go beyond simply improving the physical environment. Focus on how people feel to work there. Evaluate the energy when you walk the floors. How connected to their teams do virtual or remote workers feel? Make changes to ensure that the work environment fuels your objectives and helps to achieve your goals.

7. **Appreciate and Reward Your Employees.** Develop and deploy a schedule that regularly and meaningfully rewards employees to create a culture of appreciation. Assess and improve the way you reward people so that you are sensitive and responsive to the differences in age, education, maturity, and demographics.

8. **Focus On the Things That Inspire Your People.** Identify what inspires you and your employees. Do they need more education and training, more creative time and cross-training opportunities, wellness programs to promote less stress and better health, or even a sabbatical? Develop and improve the key programs that your people need to stay engaged and loyal.

9. **Improve The Most Important Things First.** Identify the most significant of your short comings head-on. Identify what is impacting your own progress and what is holding you back. Are you a poor listener, a technophobe, or do you yell and rave? Admit it. Then take action to get help, fix your problem, and improve your own performance, skills and abilities.

10. **Visualize the Future.** Identify where you see yourself in 10 years, 20 or even 30 years? Define the characteristics of the leader you want to be and what the future looks like for you. Describe the way you will balance your personal life and that of your organization and its people. Document how you will build loyalty and trust with your leadership.

The Power of Magnetic Leadership is a vault of valuable business strategies based on Durkin's decades of experience changing the leadership course of major corporations. It provides insight on how leaders can lead magnetically by fully engaging and empowering employees, transforming them into innovative thinkers and major contributors to the organization's success.

Full Planet, Empty Plates: the New Geopolitics of Food Security

By Lester R. Brown, Published by W.W. Norton & Co, New York, Paperback, 144 pages, \$16.95. ISBN 978-0-393-34415-8.

Although food has become a globalized commodity, availability is increasingly an issue of priorities and political decisions at the local and national levels. Lester Brown, well-known author and expert on world food and resources, warns in the preface of *Full Planet, Empty Plates* that we are moving toward serious trouble with food shortages that will likely cause large increase in prices, unrest, and political instability. Although the tide of globalization has been touted as a boon for everyone, a rising tide that would raise all ships, Brown proposes that the current system in fact is pushing us toward a “new geopolitics of food scarcity” and a food future where it is “every country for itself.”

This thesis is supported by undisputed facts: continued increase in human population, improved diets for those who can afford them, competition between food and fuel, soil erosion and conversion of land to non-farm uses, genetic plateaus in yields of major grain crop species, increasingly unpredictable and variable weather, scarcity of key production resources, and appropriation of fertile farmland by countries rich in capital but poor in land and water. These issues are explored in the first ten chapters of this well-researched and timely book.

Impressive gains in production and resulting food abundance due to the Green Revolution have given way to shortage, hunger, and political strife, clearly a result of the doubling of world grain prices between in the past decade. Among other driving factors, population growth, newly achieved affluence and demand for more protein in the diet, and converting food crops into fuel are noteworthy changes. From a comfortable safety net of grain carryover of more than 100 days supply, we have reached the point where current production each year is essential to meet the immediate demands. The U.N. Food Price Index has gone from 100 (2002-2004) to over 200 in mid-2012, resulting in one billion people who are chronically hungry. Brown cites a number of specific cases especially in Africa and South Asia, areas that have become food deficit regions. Some of these countries are seeking land elsewhere to assure their national food needs, and some of the countries most in need of food are selling or leasing land for short-term gains that often go to a few wealthy people.

These conclusions are supported by data on population growth, especially evident in developing countries where food is already in short supply, and by examples such as the annual world consumption of meat that has gone from 50 to 280 million tons in

a mere 60 years from 1950 to 2010. Global ocean fish stocks are being depleted, and most production now is found in aquaponic systems. Citing U.S. statistics on grains used for fuel, currently over half of the corn and sorghum crop is going into ethanol production, up from virtually none in 1980. Clearly more research is needed to increase yield potentials from current cropland, an ecological intensification of production that makes most efficient use of scarce resources, yet these potentials are constrained by both biological realities and by political decisions.

In the closing chapter, Brown provides a partial greenprint for solving the food dilemma. He presents four pressing needs on the demand side: “*stabilize world population, eradicate poverty, reduce excessive meat consumption, and reverse biofuel policies that encourage the use of food, land, or water that could otherwise be used to feed people.*” On the supply side, he cites growing challenges such as “stabilizing climate, raising water productivity, and conserving soil.” Our current university research is exploring more efficient carbon capture, using rainfall and irrigation as productively as possible, and reducing erosion by promoting no-till farming practices. Yet we need more emphasis in both education and research on the importance of analyzing whole systems, and taking a long-term view of resource use and potential productivity. Both the recent *Agriculture at a Crossroads*, an IAASTD document from the U.N., and a report *Nourishing the World: Scaling Up Agroecology* by the Ecumenical Advocacy Council point to the need for comprehensive, holistic, and environmentally-informed strategies for long-term food production. This perspective should be central to our university programs, and the new book by Brown is a valuable summary that describes in general terms what needs to be done.

Author Lester Brown was director of the USDA International Agricultural Development Service in the 1960s, then founded the nonprofit Overseas Development Council. His greatest impact has been through his articulate and consistent voice of concern about the very real limits to growth, first as founder of WorldWatch Institute and currently as president of the Earth Policy Institute. The annual *State of the World* and *Vital Signs* publications have provided well-documented evidence for challenging the wisdom of continuing growth in national and global economies. The series *Plan B* brought together compelling data in a narrative form and offered positive directions for the future. *Full Planet, Empty Plates* is probably his most accessible and concise book on the current need for new directions.

Using language geared for a general audience, Brown concludes that “what we need most of all is

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for the market to tell the environmental truth.” As a seasoned economist, he believes that the market can sort things out, but only if we are able to internalize many of what today are considered environmental externalities, and to monetize in some way the use of non-renewable resources and provision of ecoservices on which human society depends. Full Planet offers viable directions for the future, if we have the individual and political will to make drastic changes in our current excessive consumption. There can be enough food for all, but business as usual will not help us achieve that critical goal.

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Another Chance

**By D Ivan Young, Reality-N-3D Publishing, Inc.,
Houston, TX, Softcover, \$24.95, ISBN 978-0-
9665132-5-7**

How do you deal with a still unfulfilled life? If you could get a second chance at life, what would you do?

It does not matter what your religious beliefs are, what your nationality is, your race or your gender or even how much money you do or don't have. No matter what you've done in your life, no matter who you have hurt or who has maimed you, no matter what you've achieved or failed to accomplish, you're still alive. You're here for a reason and you have the power to choose how to live the rest of your life. So what do you want to do?

Like most of us, Dr. D Ivan Young has had to face up to his failures and short comings, and understands the pain we are feeling and going through. His new book *Another Chance...Where Would You Be Without One!* has profound words of advice for both men and women who want transformation, who need help in making the right decisions, so that they can become the very best that they can possibly be. Nonetheless, he isn't going to mince words or hold back anything. He is not about warm fuzzies. Dr. D provides the guidance that helps us to master the tools necessary for living a profoundly extraordinary life.

Dr. D Ivan Young understands that lots of people are feeling pretty lost in the world we live in. Today people need some hard evidence that they are on the right path. They need something special that changes their life, revamping it so they can achieve their true destiny. This book provides the step by step insight we need to bring lasting transformation to our lives.

But unfortunately all they really have is the lingering pain of a bad experience with someone, a lot of confused feelings, time on their hands and maybe a cell phone. Okay, they've got the memories of the past and the shattered hopes and false expectations built on habits that feel like an itch you can't reach, scratch, let alone get rid of anymore.

So he's going to give it to you straight. From this moment forth, nothing that has happened to you really matters. Why, what, or who is to blame is inconsequential. Truth be told If, you're going to change for the better and change the way things go today, you must become accountable for everything. Dr. D Ivan Young's, *Another Chance* will help you to discover where beauty is in your ashes.

You have the green light. It's time for you to choose the better portion of what life has to offer. He's going to tell you exactly what you need to do to get started. It's going to allow you to not only get on with your life but create a whole new and better life. So get ready and get set, for here's what you need to do. Here's a sampling of what you are in for:

Leaving the Comfort Zone - Far More Than A First Step

Whatever the case, those choices you've made have landed you right where you are today. The sooner you come to grips with this reality, the better. It isn't good, nor is it bad; it just is what it is. The good news, however, is that those choices brought you to this moment and prepared you to take full advantage of it. A good question to ask yourself now is, "Where does that leave me?"

Well, to answer you, it leaves you in a wonderfully exciting place filled with unlimited possibilities, immeasurable chances, and limitless options. Never have you been in such a good position to be successful at whatever you set your mind to. And beyond that, you have the power to choose who and what you want to be.

However, deciding to do something about your future is the most important decision you will ever make. Scary isn't it?

Starting from Scratch - And You Thought It Was A Curse

Seldom does anyone just pop out of bed saying, "Let me get my **** together today." If only it were that simple, but it isn't. The truth is, most people need to lose something first, something they took for granted, before they heed life's wake-up call. It is called the TUI-SOYB Effect, which stands for The Universe Is Sick of Your B.S.

If you are like most people, frustration, circumstances, and failure force you to raise the white flag. It usually takes a combination of loss, embarrassment, shame, and guilt for most people to finally come to the realization

that they had better give up their old ways of thinking and behaving.

After bumping your head for the second or third; perhaps even fourth or fifth time, fate has coerced you into accepting the fact that if you don't immediately change how you live your life, you won't have a life.

Change demands action. The time to start is right now.

Everything Happens for a Reason - You're Not Alone

Every significant thing taking place in your life right now is happening for a reason. Whether you accept it or not, divine forces are working on your behalf. You are not alone in this. But it is up to you to embrace or reject the helping hands.

A Geiger Counter goes off whenever it senses radioactivity in anything within close proximity. Your internal guidance systems function in much the same way. The closer you get to doing the right thing, especially at the right time, your spirit bears witness unto itself. The more motivated and enthused you become, the more your spirit resonates because you're in the right place, at the right time, doing the right thing. That's not a bliss-filled co-occurrence. It's your inner being, a.k.a., your "Spirit," reaffirming that you are on target.

This internal system validates, or invalidates, everything you do. It reacts vehemently each time you connect with your divine purpose. The exact opposite takes place when you're doing something stupid, something that's not in your best interest, or something not serving your

greatest of good. Whenever your enthusiasm drops like crap from a bird on a newly-washed car, it's confirmation you're out of sync with your purpose. It's affirmation that you are exactly where you ought not be. Anytime you feel those hairs standing on your arm, or an unsettling feeling in your gut, trust what you are feeling, move around, and do so quickly.

So wake up! Tune in. Pay attention. And turn on the light within you.

Another Chance is a roadmap for anyone who's trapped by past anger, guilt and the pressures of an unfulfilled life. D. Ivan Young offers straight talk, tell it like it is language that anyone can understand. This book is a specialized tool designed to help set you free from your therapist, stop calling and worrying your friends, wipe the tears away and help you get on with the rest of your life

Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences

Edited by Debasis Bagch, Wiley-Blackwell, Hardcover, 824 pages, \$299.95, ISBN: 978-0-470-67037-8

Bio-nanotechnology is the key functional technology of the 21st century. It is a fusion of biology and nanotechnology based on the principles and chemical pathways of living organisms, and refers to the functional applications of biomolecules in nanotechnology. It encompasses the study, creation, and illumination of the connections between structural molecular biology, nutrition and nanotechnology, since the development of techniques of nanotechnology might be guided by studying the structure and function of the natural nanomolecules found in living cells. Biology offers a window into the most sophisticated collection of functional nanostructures that exists.

This book is a comprehensive review of the state of the art in bio-nanotechnology with an emphasis on the diverse applications in food and nutrition sciences, biomedicine, agriculture and other fields. It describes in detail the currently available methods and contains numerous references to the primary literature, making this the perfect "field guide" for scientists who want to explore the fascinating world of bio-nanotechnology. Safety issues regarding these new technologies are examined in detail.

The book is divided into nine sections – an introductory section, plus:

- Nanotechnology in nutrition and medicine
- Nanotechnology, health and food technology applications
- Nanotechnology and other versatile applications
- Nanomaterial manufacturing
- Applications of microscopy and magnetic resonance in nanotechnology
- Applications in enhancing bioavailability and controlling pathogens
- Safety, toxicology and regulatory aspects
- Future directions of bio-nanotechnology

The book will be of interest to a diverse range of readers in industry, research and academia, including biologists, biochemists, food scientists, nutritionists and health professionals.

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