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the professional journal advancing the scholarship of teaching and learning in agricultural, environmental, natural and life sciences

Contents

Early Field Experience of Business and Family and Consumer Sciences Teacher Education

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Abstract

The purpose of this national descriptive study was to describe early field experience (EFE) practices used in business and family and consumer sciences (FCS) teacher education by using the EFE model. This study replicates similar research in the agricultural education discipline. For this study, EFE was defined as all field experiences—offered within or outside of the business and FCS teacher education curriculum—that occur before student teaching. The study population was business and FCS teacher education programs (*N*=139) identified by the American Association of Family and Consumer Sciences and the National Business Education Association. The teacher education coordinator for each program was the contact for this study. Data were collected via an online survey. Programs required a minimum number of contact hours and a minimum number of lessons taught while in the field. The most common student assessments included cooperating teacher signatures, reflective writing and university supervisor's review of documents. Most programs had specific EFE requirements and expectations. This study supports the career and technical education profession by identifying differences and similarities in EFE programming across disciplines. This information could be used to provide a more congruent EFE for all preservice teachers.

Keywords: early field experience, preservice education, business education, family and consumer sciences

Introduction

An early field experience (EFE) is one aspect of the process for any student preparing to enter the teaching profession. An EFE allows preservice teachers to begin experiencing—or immerse themselves in—a real classroom environment.

Guyton and Byrd (2000) defined EFE as the range of school experiences that occur prior to student teaching for students in preservice teacher education. The interaction with peers, cooperating teacher and teacher coordinator is known as the triad. This triad is vital for the preservice teacher to learn from the EFE and develop an understanding of the profession (McIntyre et al., 1996).

Pierce (1996) suggested that learning is authentic in EFE, and that learning should be taking place early and regularly. Authentic classroom experiences like EFE are necessary because they create significant learning experiences for preservice teachers (Aiken and Day, 1999). To ensure effectiveness, EFE should be aligned with the entire teacher preparation program (Little and Robinson, 1997).

The National Council for Accreditation of Teacher Educators (NCATE, 2008) identified the purpose of EFE as the application of preservice teacher knowledge and skills in various settings. This purpose can be accomplished by many early school-based opportunities, which could include teaching lessons, tutoring students, or observing in the classroom (NCATE, 2008). NCATE requires institutions to develop a purpose statement, outline the educational process and define student outcomes as part of a conceptual framework for their teacher education program. These frameworks meld EFE and courses taught on campus (McIntyre et al., 1996).

Educators have not disputed the importance of EFE (Guyton and Byrd, 2000). However, Hudsonet al. (1993) identified five issues that affect the impact and effectiveness of EFE: (a) lack of a common goal, (b) lack of control, (c) limited learning due to the lack of experiences the preservice teacher can compare, (d) the difference between what is being practiced in the classroom and what is being taught on campus and (e) limited opportunities. Moore (2003) noted that many EFE are procedural activities that focus on time management, classroom management and content.

Much has been written about EFE, but little research has been conducted—especially in career and technical education. In recent years, EFE has been explored in the agricultural education discipline (Retallick and Miller, 2007, 2010; Smalley and Retallick, 2011, 2012). Retallick

and Miller (2007) found that agricultural education EFE programs require a minimum number of contact hours and a minimum number of lessons planned and taught. Additionally, EFE offerings are driven by internal and external factors including licensure as well as state and national accreditation. Having a quality EFE is important for all preservice teachers because it helps ensure they are prepared for the teaching profession.

Smalley and Retallick (2012) confirmed that agricultural teacher education programs were requiring a minimum number of contact hours and minimum number of lessons taught while in the field. In addition, they found that the most common student assessments included university supervisor's review of documents, cooperating teacher signatures, reflective writing and student journaling.

Our literature review revealed no EFE research in other career and technical education disciplines, including business and family and consumer sciences (FCS). Because many secondary teacher licensure programs rely on faculty to develop, facilitate and evaluate students' field experiences, including EFE, it's important to have a clear understanding of the EFE practices used in all teacher education disciplines.

Purpose and Objective

The purpose of this national descriptive study was to describe current EFE practices used in business and FCS teacher education. The study focused on two research questions:

1. What EFE practices—in both business and FCS teacher education—occur in each component of the EFE model (i.e., foundations, organization, implementation and assessment)?
2. Do differences exist between business and FCS teacher education EFE programs?

Theoretical and Conceptual Frameworks

The conceptual framework for this study is Retallick and Miller's (2010) model for EFE in teacher education, which was developed to address the need for a comprehensive EFE model for teacher education and is the only known EFE model. The model identifies four major components of EFE (Figure 1): foundation, organization, implementation and assessment.

The foundation component includes teacher education standards and a conceptual framework, which provides a basis for how EFE can evolve. The organization component involves syllabi, forms, handbooks and other documents; placement; and embedded or standalone experiences. The implementation component includes four elements: (a) interactions among EFE participants, university supervisors, cooperating teachers, and peers; (b) orientation to outcomes and learning strategies; (c) outcomes; and (d) learning strategies necessary to accomplish the outcomes. The final component addresses the need for individual and program assessment.

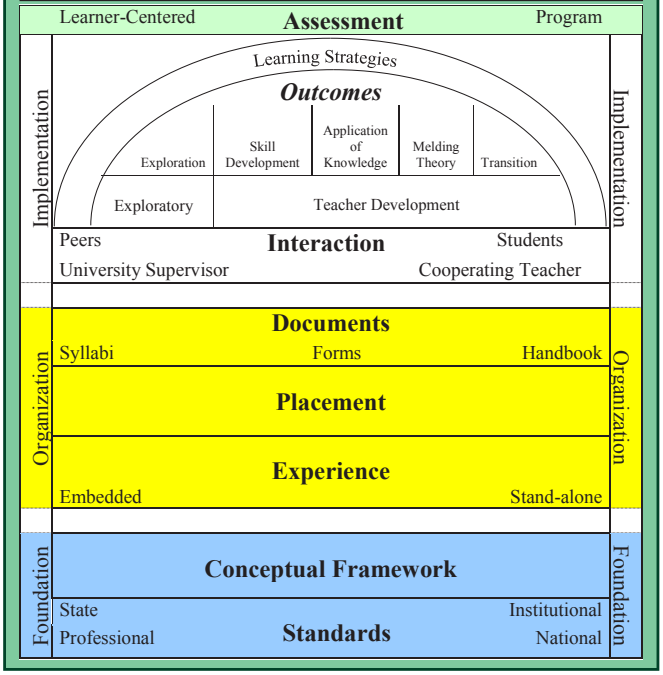
Smalley and Retallick (2011) further enhanced the EFE model by asking agricultural teacher education experts to identify appropriate types of interaction and activities. According to that study, EFE should be documented via a combination of journaling and portfolio development. And those documents should be verified by the cooperating teacher and through university assessments. Students can document an EFE through journaling, cooperating teacher signatures, reflective papers, or a review of collected documents.

Methods

This national descriptive survey study was a replication of research conducted by Smalley and Retallick (2012) to explore current use of EFE practices agricultural education. Because the study purpose was identical expect for discipline, the same online survey instrument was used. The survey was modified to reflect business and FCS language.

The survey had five parts: implementation, assessment, foundation, organization and demographics. The implementation section covered EFE interaction, activities and assessment. Respondents were asked to identify from 15 statements the purpose of EFE. For this study, the statements were categorized as either exploratory or teacher development in nature. Exploratory was defined as providing students the opportunity to investigate the profession and develop an understanding of what it means to be an educator. Teacher development was defined as the stage of development after students have explored and determined that teacher education is the career for them. During this stage, preservice teachers begin to transition from student to teacher by developing and enhancing skills and knowledge prior to entering the teaching profession (Retallick and Miller, 2010).

Figure 1. Model for early field experiences in teacher education (Retallick and Miller, 2010).



The assessment section, which consisted of nine statements, asked respondents to identify the type of assessment used in their program and what type of review is conducted of their program. The assessment questions were specific to student assessment and the review questions focused on program review.

The foundation section included two questions regarding standards that drive the EFE program and the type of accrediting body that oversees the program.

The organizational section had three parts. Respondents were asked to identify how EFE activities, placement and documents are handled.

Cronbach's alpha was computed to assess the internal consistencies of the summated scales in Smalley and Retallick's (2012) survey. The coefficients obtained for each section of the instrument included interaction were 0.84, 0.81 for activities and 0.74 for assessments. A panel of experts including agricultural teacher educators and graduate students reviewed the survey for content validity and their suggestions were integrated. The survey was pilot tested for face validity. Panelists were asked to read the items carefully and indicate if any of the items were not suitable. This study was exempt from IRB approval, since adults were the human subjects.

The study population consisted of all business (*n*=65) and FCS (*n*=74) teacher education programs (*N*=139) identified by contacting the American Association of Family and Consumer Sciences and the National Business Education Association, respectively. The teacher education coordinator for each program was the contact for this study.

Data collection followed Dillman's (2009) electronic survey plan, which includes four contacts and a special contact. For this study, a special contact was a phone call to non-respondents. For this study, EFE was defined as all field experiences—offered within or outside of the business and FCS teacher education curriculum—that occur before student teaching. This definition was provided in the cover letters and the introduction to the survey.

The overall response rate was 66.90%; 40 of 65 (61.53%) business and 53 of 74 (71.62%) FCS teacher education coordinators responded. To control for non-response error, early and late respondents were compared; no significant differences were found.

Findings

Respondents represented programs at several types of institutions: regional/state (58.52%), 1862 land grant (14.82%), private (14.63%) and 1890 land grant (12.19%). A majority of programs (89.02%) offered a Bachelor of Science in business and FCS teacher education, 4.87% offered a Bachelor of Science plus one year, 21.95% offered a Master of Science in business and FCS teacher education and 26.82% indicated they offered other degrees.

We report the remaining findings in the context of Retallick and Miller's (2010) EFE model (Figure 1).

Foundation

The foundation component of the EFE model includes teacher education standards and a conceptual framework. Respondents identified state standards (82.79%) and institutional standards (73.11%) as the most influential in driving their EFE program (Table 1).

For accreditation, the majority of programs (81.72%) were associated with NCATE (Table 2). During the study, NCATE and the Teacher Education Accreditation Council (TEAC) voted to consolidate and formed a new accrediting body called the Council for the Accreditation of Education Programs (NCATE, 2010).

Organization

The organization component of the EFE model involves experience, placement and documents.

Experience. An EFE can be part of a course or a stand-alone experience. Respondents were able to identify all ways their programs offer an EFE. Overall, it was most common for EFE to be embedded within a course (80.64%) and also stand-alone experiences. This was also the case within each discipline: FCS and business respondents reported that 84.90% (*n*=45) and 75.00% (*n*=30), respectively, of EFE were embedded within a course. Overall, 43.01% of EFE were considered stand-alone experiences. The FCS and business respondents identified 33.96% (*n*=18) and 55.00% (*n*=22), respectively, of EFE as stand-alone experiences.

Programs require students to complete unique EFE activities throughout their teacher education program. Overall, 21 (22.58%) program coordinators reported their EFE students complete four unique experiences. This total represents 13 (24.52%) FCS respondents and 8 (20.00%) business respondents.

Placement. Programs offer EFE at many different stages of preservice teacher development to help students transition from student to teacher. In terms of timing, no single grade level or combination of grade levels emerged from the data.

Appropriate EFE placement is crucial to ensuring that preservice teachers have a quality experience. Half

Table 1. Standards that Drive Early Field Experience Program

	FCS		Business		Total	
Standard (n=93)	n=53	%	n=40	%	n=93	%
State	43	81.13	34	85.00	77	82.79
Institutional	44	83.01	24	66.70	68	73.11
National	36	67.92	27	75.00	63	67.74
Professional	32	60.37	26	72.20	62	66.66
Other Standards	1	2.00	0	0.00	1	1.07

Table 2. Accrediting Body for Teacher Education Program

	FCS		Business		Total	
Accrediting agency/organization (n=93)	n=53	%	n=40	%	n=93	%
National Council for Accreditation of Teacher Education (NCATE)	42	79.24	34	85.00	76	81.72
Other Accreditation	24	45.28	21	52.50	45	48.38
State Accreditation	18	33.96	19	47.50	37	39.78
Teacher Education Accreditation Council (TEAC)	6	11.32	3	7.50	9	9.67
National Board of Professional Teaching Standards (NBATS)	3	5.66	3	7.50	6	6.45

of the respondents reported that their programs required preservice teachers to select an EFE site from an approved list and 83% of programs required preservice teachers to complete their EFE in a high school or middle school education program. Fifty-three percent of all programs did not require students to complete an EFE before being admitted to the teacher education program. On average, the minimum numbers of hours expected of students to participate in EFE for licensure was 110 hours (range: 20 to 200 hours).

Most programs (70.93%) offered an orientation to EFE students. This was also true in each discipline: 67.92% (*n*=36) of FCS programs and 75.00% (*n*=30) of business programs offered an orientation for EFE students. However, in most cases, FCS programs did not offer orientations for college/university staff 41.50% *(n=22)* or cooperating teachers 49.05% (*n*=26). Only some business programs provided an orientation for college/university staff 50.00% (*n*=20) and for cooperating teachers 42.50% (*n*=17).

More than 60% (62.36%) of all programs had minimum qualifications for teachers to be eligible to serve as an EFE cooperating teacher. This number was higher for FCS programs (66.03%, *n* = 35) and lower for business programs (57.50%, *n*=23). Approximately half (49.46%) of all programs required a minimum number of site visits to the secondary program as part of the EFE. This number was lower for FCS programs (47.16%, *n*=25) and higher for business programs (52.50%, *n*=21).

Documents. Documents for an EFE program can include handbooks, lesson plans and evidence of teaching a lesson. Overall, 73.11% of programs used a handbook or bulletin to communicate with preservice teachers. Just 66.03% *(n=35)* of FCS programs used a handbook or bulletin, whereas 82.50% (*n*=33) of business programs did so.

More than half of all programs (58.06%) required preservice teachers to plan a lesson as part of their EFE. Additionally, almost three-fifths (59.13%) of all programs expected preservice teachers to teach a lesson. Within the disciplines, 56.60% (*n*=30) of FCS programs and 60.00% (*n*=24) of business programs required preservice teachers to plan a lesson. And 54.71% (*n*=29) of FCS programs and 65.00% (*n*=26) of business programs expected preservice teachers to teach a lesson. On average, respondents indicated that their programs expected preservice teachers to teach six lessons during the EFE.

Implementation

The implementation component of the EFE model involves interaction, activities and assessment. In nearly two-thirds (61%) of programs, some collaboration occurs among the preservice student, the EFE cooperating teacher and the teacher educator during the required EFE. Respondents also reported no collaboration (8.79%), very little collaboration (12.08%) and much collaboration (17.58%).

EFE interactions can be exploratory or related to teacher development. Respondents identified the purposes of their program's EFE from among 16 listed types of interactions (Table 3).

Overall, the most common purpose of an exploratory EFE was to identify the roles of professional educators (69.89%). Within the disciplines, 71.69% (*n*=38) of FCS respondents and 67.50% (*n*=27) of business respondents identified this as the purpose of an exploratory EFE. Overall, the most common purpose of a teacher-development EFE was to identify skills development (classroom instruction/management, program planning) of a teacher (80.64%). Within the disciplines, 83.01% (*n*=44) of FCS respondents and 77.50% (*n*=31) of business respondents identified this as the purpose of a teacher-development EFE.

Table 4 lists 13 activities respondents report using within their EFE program. Nearly all programs (92.47%) have a preservice teacher observe a cooperating teacher. Programs are less likely to provide student-led preservice teacher discussions (47.31%) and review case studies in a university setting (39.78%). Other types of EFE activities identified but not listed in Table 4 include grading papers, tutoring students, observing middle school, classroom management procedures and observing other teachers outside of the business or FCS discipline.

Assessment

There are two types of EFE assessment: program and student. Respondents identified how EFE are

Table 3. Purpose of Early Field Experience, Grouped by Type

	FCS		Business		Total	
Interaction (*n*=93)	*n*=53	%	*n*=40	%	*n*=93	%
Exploratory						
Identify the roles of a professional educator	38	71.69	27	67.50	65	69.89
Observe classroom instruction	37	69.81	27	67.50	64	68.81
Affirm the desire for becoming a family consumer sciences teacher/business educator	35	66.03	25	62.50	60	64.51
Develop observational skills and techniques	34	64.15	24	60.00	58	62.36
Teacher Development						
Identify skill development (classroom instruction/ management, program planning) of a teacher	44	83.01	31	77.50	75	80.64
Recognize a successful teaching strategy	42	79.24	31	75.00	73	78.49
Identify cooperating teacher behavior/s that influences student behavior	41	77.35	30	75.00	71	76.34
Interact with community members, school staff, and administration	42	79.24	28	70.00	70	75.26
Recognize a successful classroom and laboratory management strategy	40	75.47	30	75.00	70	75.26
Develop understanding of a complete business/ family and consumer sciences program	42	79.24	26	65.00	68	73.11
Recognize awareness of student engagement	39	73.58	28	70.00	67	72.04
Develop understanding of what is involved in being a business and family and consumer sciences teacher	37	69.81	29	72.50	66	70.96
Have a positive experience	37	69.81	28	70.00	65	69.89
Define and describe characteristics of an effective teacher	37	69.81	25	62.50	62	66.66
Educate preservice teacher about what is means to learn to teach as they reflect on why, whom, and how they will teach	34	64.15	27	67.50	61	65.59

documented in their program (Table 5). Nearly all programs document EFE with cooperating teacher signatures (80.64%), preservice student reflection papers (75.26%) and university supervisor's review of documents (73.11%). Additional methods of documentation identified but not listed in Table 5 include discussion with program advisory council, completing an online portfolio, completion of a lesson and having a faculty member observe the preservice student teaching a lesson.

Table 4. Early Field Experience Activities

	FCS		Business		Total	
Activity (*n*=93)	*n*=53	%	*n*=40	%	*n*=93	%
Preservice teacher observation of cooperating teacher	50	94.33	36	90.00	86	92.47
Orientation from university faculty on the expectation of EFE	48	90.56	33	82.50	81	87.09
Observation of student's behavior by preservice teacher	47	88.67	31	77.50	78	83.87
Develop reflection paper throughout experience (micro-reflections)	45	84.90	32	80.00	77	82.79
Note taking of observations while on EFE	44	83.01	32	80.00	76	81.72
Preservice teacher teaching a lesson	41	77.35	33	82.50	74	79.56
Observation of student's learning by preservice teacher	45	84.90	27	67.50	72	77.41
Develop written portfolio documentation of experience	38	71.69	26	65.00	64	68.81
Compile list of information regarding the EFE program visit	31	58.49	23	57.50	54	58.06
Interviewing middle/high school students, cooperating teacher, school counselor, principal, etc.	30	56.60	24	60.00	54	58.06
Observing the supervision of student BPA/DECA/FCCLA projects and activities	32	60.37	15	37.50	47	50.53
Student-led discussion by preservice teacher	27	50.94	17	34.00	44	47.31
Review case studies in a university setting	23	43.39	14	35.00	37	39.78

Evaluation of an EFE program can occur at various levels and is important to the continued success of an EFE program. Overall, 78% of respondents reported their EFE program was evaluated, and a departmental review was most common (63.44%) (Table 6).

Table 5. Assessment of Early Field Experiences

	FCS		Business		Total	
Documentation (*n*=93)	*n*=53	%	*n*=40	%	*n*=93	%
Cooperating teacher - certification/signature	43	81.13	32	80.00	75	80.64
Preservice student completing a reflective paper on experience	41	77.35	29	72.50	70	75.26
University supervisor review of documents	40	75.47	28	70.00	68	73.11
Journaling of experience	35	66.03	27	67.50	62	66.66
Cooperating teacher evaluation	34	64.15	26	65.00	60	64.51
Development of a portfolio	36	67.92	21	52.50	57	61.29
Seminar for EFE students to discuss and compare experiences as a group	36	67.92	18	45.00	54	58.06
Preservice student completing an observation of the visited business/family and consumer sciences education program (reviewing teaching resources, curriculum, facilities, budget, etc.)	34	64.15	17	42.50	51	54.83
Collection of key resources and documents	33	62.26	16	40.00	49	52.68

Conclusions, Recommendations, and Implications

"The overarching outcome of EFE is the establishment of lifelong learning strategies and skills, which can be transferred to the student teaching practicum and continued throughout an individual's teaching career" (Retallick and Miller, 2010, pp. 70–71). The findings of this study indicate that the majority of FCS and business teacher educations programs have quality EFE that are developed using national, state, institutional and professional standards and adhere to the standards of at least one accrediting body. These EFE are usually embedded within a course and occur in a middle or high school setting. Preservice teachers who participate in these EFE often receive an orientation and have access to a handbook or bulletin. A large proportion of FCS and business teacher education EFE programs are designed for similar purposes and use similar activities and assessments.

This study also revealed a few differences between FCS and business teacher education programs in the elements of EFE that were not prevalent among all programs. Stand-alone EFE are less common in FCS (33.96%) than in business (55.00%). Only half of all programs use an approved list of EFE sites for students to select from, yet 62.36% of programs have minimum qualifications for cooperating teachers. Surprisingly, less than half (47%) of programs require that students complete an EFE before being admitted to the teacher education program. Additionally, only three-fifths of programs require preservice teachers to develop a lesson plan and teach a lesson.

Table 6. Level of Early Field Experience Evaluation

	FCS		Business		Total	
Level of review (n=93)	n=53	%	n=40	%	n=93	%
Departmental	34	64.15	25	62.50	59	63.44
Accreditation	36	67.92	22	55.00	58	62.36
State review	22	41.50	22	55.00	44	47.31
University	25	47.16	12	30.00	37	39.78
Other levels	3	5.66	0	0.00	3	3.22

Most business and FCS teacher education EFE programs use a variety of student assessments. The most common student assessments are the university supervisor's review of documents, cooperating teacher signatures and reflective writing. However, FCS and business programs differ in the extent to which they use other assessments. The FCS programs are more likely to use seminars for EFE students to discuss and compare experiences as a group, complete an observation of the visited education program (reviewing teaching resources, curriculum, facilities, budget, etc.) and require a student to collect key resources and documents. There was difference between disciplines in the use of a handbook or bulletin for communication with preservice teachers; business programs (82.50%) use this resource more than FCS programs (66.03%)

While the responses of both business and FCS faculty in this study were relatively similar, but there are some differences between these findings and those from Smalley and Retallick's (2012) study, which focused on agricultural teacher education. Agricultural education programs are more likely to be housed at 1862 land grant

intuitions, whereas the majority of FCS programs are at a regional or state institution. Nearly all agricultural education programs offer an orientation program. Agricultural education programs use EFE handbooks at nearly the same rate (69.09%) as FCS programs, but much less than business programs. Agricultural education EFE participants also teach considerably more lessons (*n* = 14) than business and FCS EFE participants.

This study has implications for teacher education programs that are planning to evaluate their current programs or preparing to revamp their EFE programs. This study reveals the extent to which teacher education programs in two career and technical education disciplines (business and FCS) use elements identified in Retallick and Miller's (2010) EFE model. These results can be used as comparisons for FCS and business teacher education programs nationwide.

"While the overall development and implementation of EFE is as individual and contextual as teaching itself, consistency among teacher education programs using best EFE practices as identified in the literature will provide a better experience for all students and ensure the student learning outcomes of EFE are achieved" (Retallick and Miller, 2010, p. 71). Retallick and Miller (2010)'s model provides the framework to answer the necessary questions when evaluating and developing EFE programs and offers a synthesis of learning strategies to meet the various learning outcomes associated with EFE. Referencing this work will ensure that each element of EFE is addressed and best practices are used. It will also ensure that all teacher education programs, including those in CTE, have continuity and consistency in EFE programs (Retallick and Miller, 2010), which addresses Zeichner's (1996) concern that EFE programs lack the rigor and relevance of other college coursework and teacher education components.

Expanding opportunities for preservice teachers during the exploratory and teacher development stage will increase the number of real-world opportunities they have prior student teaching. This could, in turn, affect recruitment and retention of preservice teachers as well as introduce them to the lifelong learning skills required in the teaching profession.

Further research needs to take place to determine if changes have occurred in career and technical education programs based on the activities and assessments provided to preservice teacher education students. Ongoing monitoring of the EFE model is required to determine if changes occur in the foundation, organization, and implementation stages. Additional research could address how often career and technical education programs' EFE are regularly reviewed and how recommendations are handled.

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Assessment for Learning: Integration of Assessment in a Nutrition Course with a Service-Learning Component

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Abstract

The inclusion of service-learning in higher education is an opportunity to enhance experiential curricula to increase student success post-graduation in the current dynamic and challenging job market. However, designing effective assessments to measure learning that takes place outside the classroom may be a difficult aspect for educators interested in including community-based learning opportunities in their curricula. A 2014 Community Nutrition course incorporating a service-learning assignment is used as an example of Assessment for Learning to achieve predetermined learning objectives. The purpose of this paper is to illustrate how educators can implement structured, multi-faceted assessment within service-learning using intentionally designed assignments that include multiple points of feedback to students, providing opportunities for reflection and learning. Examples of assessment tools that can be applied to a variety of class structures and environments are also provided.

Keywords: assessment for learning, service-learning, experiential learning

Introduction

In 2012, the Academy of Nutrition and Dietetics (AND) Council on Future Practice released a visioning document recommending to revise the undergraduate curriculum for dietetics education programs to include requirements for practicum and diverse learning experiences outside of the classroom to develop students' critical thinking, leadership, communication and management skills by providing opportunities to experience them in the context of professional work settings (ACEND, 2012). Inclusion of this kind of experiential learning in dietetic programs mirrors broader calls within higher education to expose students to more active, authentic learning experiences and represents an opportunity to enhance curricula to better prepare future health professionals to succeed in a dynamic and challenging field. Other competencies suggested in 2015 included development of communication skills to transfer knowledge, cultural communications, written and verbal communication skills, knowledge of determinants of health and diversity, critical thinking and cultural care (ACEND, 2015).

Service-learning, one of the identified high-impact practices in higher education, facilitates deep learning and fosters general, personal and practical gains through a practice that students may enjoy more than the traditional lecture (Kuh and O'Donnell, 2013; Stavrianeas, 2008). While studies illustrate the best practices within service-learning, the process of embedded assessment that is formative and ongoing throughout the semester where the activity takes place is minimal. This is imperative to provide evidence of student learning and to meet accreditation, and/or workforce expectations of employers (James et al., 2002).

Multiple challenges may discourage educators from including service-learning in curricula. These challenges include but are not limited to: (1) the difficulty of assessing service-learning assignments where the bulk of the assignment takes place out of the controlled environment of a classroom, (2) policy constraints, (3) curriculum requirements, (4) pressure to "teach to the test" and (5) classroom logistics (e.g. large classroom or limited class time). The purpose of this paper is to illustrate how educators can plan and implement multi-faceted service-learning experiences with embedded assessment measures utilizing a Community Nutrition course at a land grant university as an example. Examples of different strategies to assess student learning are also provided.

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Conceptual Framework: Assessment for Learning

Educators must move from assessment of learning to an Assessment for Learning (AfL), where assessment is embedded in education and is, in itself a learning process (Huba and Freed, 2000; Martinez and Lipson, 1989; Schuwirth and Van der Vleuten, 2011; Swaffield, 2011). Premises of AfL include clarifying and sharing criteria and learning intentions with learners, facilitating assessments that produce evidence of student learning, providing meaningful feedback for learners and having students take ownership of their own learning while serving as resources for each other (peer and self-assessments) (Swaffield, 2011; Wareing, 2012). AfL involves moving beyond grades as a metric (summative or occurring at the end of the learning process) to use for improvement of student learning and adaptive use of pedagogical technique based on a feedback process (summative and formative, or an iterative assessment occurring during the learning process). Given that students value assessment above other elements of a curriculum, Kearney (2012) posits that educators should use this to their advantage to engage students and enhance learning. Unfortunately, this kind of authentic assessment is often the "missing part of pedagogy" (Brookhart, 1999).

The inclusion of formative assessments does not constitute AfL, which is a learning process that includes learning how to learn and therefore better positions students for lifelong learning. Formative assessment in isolation can simply be used to guide the pedagogical process and future learning activities, concentrating on curricular objectives (Swaffiled, 2011). Highly effective assessments are included in the course design process to ensure assignments elicit necessary information, align with course teaching and learning objectives and utilize multiple measures including those that provide timely feedback on learning (James, 2008; NAS, 2009; Price et al., 2010). Finally, *"because important decisions are based on information derived from classroom assessments, it is imperative that the information be of high-quality: accurate, dependable, meaningful, and appropriate"* (Brookhart, 1999, p. 13).

Course Description

The Department of Human Nutrition, Foods and Exercise at Virginia Tech offers an accredited Didactic Program in Dietetics. Community Nutrition, a senior-level dietetics course, contributes, in part, to the knowledge and skills required to maintain accreditation of the program. This is the only course within the dietetics program in which students are exposed to the practice of community nutrition as opposed to a clinical or food service management focus.

An a priori assumption when designing this course was that students can best learn to apply classroom-based skills in community settings in culturally appropriate ways by learning in communities from community members. Service-learning experiences can help students to apply knowledge in real-world settings while improving communication skills when they are given frequent and quality feedback (Gilboy, 2009). Service-learning can also provide an opportunity for students to build awareness of cultural differences and challenge previously held assumptions about the populations that students will work within after graduation (Pierce et al., 2012). As such, service-learning structured the primary assignments/activities for the course, accounting for 55% of the course grade.

Based on Kolb's experiential learning cycle, including the concepts of abstract conceptualization, active experimentation, concrete experience and reflection observation (Kolb, 1984), 38 students were required to complete 20 hours outside the classroom with one of 12 community partners during the semester. Community partners were identified by the instructor and VT Engage, The Community Learning Collaborative at Virginia Tech which is responsible for developing short and long-term community learning opportunities for Virginia Tech students, faculty and staff (VT Engage, 2014). The course community partners included food pantries (3), Extension personnel running community nutrition programs (3), child nutrition educators (1), local farmers/community gardeners (2), fresh food pantry managers (1), a subsidized assisted living facility coordinator offering a food management planning opportunity (1), and a farmers market manager and an Americorps Volunteer in Service to America serving low-income individuals and families (Corporation for National and Community Service, 2015) (1). At the beginning of the course, community partners presented briefly about their sites and the learning experience offered to students. Following the presentations, students ranked the sites in order of preference using online survey software, noting any transportation barriers and scheduling conflicts prior to community partner selection. Each community partner was assigned at least one student in accordance with their communicated needs.

In addition to standard content-based course reading selections, The Service Learning Companion was also assigned to clarify the definition, practice and benefit of a service-learning experience to prepare them for the assignment (Duncan and Kopperud, 2008). Students were also required to articulate their own learning objectives and expectations for their service-learning experience and interview their community partners to determine mutually beneficial needs and expectations.

Assessment of Student Learning

The assessment plan was designed by an assessment team consisting of multiple faculty members with varying expertise. The team worked collaboratively to build an assessment plan that would meet the needs of the new instructor and students while contributing to accreditation requirements. Several factors, including the purpose of the assignments and the type of assessment (formative vs. summative) required, were taken into account. For a list of the assignments, assessment

Table 1. The assessment scaffolding used in Community Nutrition.

Assignment	Assessment Type	Time Commitment	Time Point	Assessment Method	Graded (Yes/No)
Personal Response System (e.g., "Clickers")	Formative	Minimal	Immediate	i-clickers	No
In class discussions	Formative	Medium	Immediate	Field notes and listening	Not explicitly (attendance and participation was required)
Reflective Writing assignment	Formative and Summative	Intensive	On-going	Weekly feedback Grade for completion	Yes
Needs Assessment Plan, Justification and Timelines	Formative and Summative	Intensive	Ongoing	Rubric	Yes
Poster Presentation	Summative	Medium	Immediate	Rubric evaluation by university and community members	Yes
Community Partner Evaluation	Summative and Formative	Medium	Immediate	Hour completion (honor system) and community partner feedback through rubric	Yes

method, time commitment by the instructor, and whether the assignment was graded, see Table 1. Another fairly unique consideration for service learning was how to assign grades to student progress and achievement in an activity that took place outside of the classroom. To address this issue, community partners were included in the grading process.

The assessment was designed to facilitate the reflective portion of Kolb's experiential learning model by including both formative and summative assessments to ensure students were making progress towards meeting the learning objectives while providing ongoing feedback to the instructor on the impact of pedagogical techniques. The assessment also provided feedback and grades in accordance with student and institutional expectations. Time commitment of the educator and the time point in which a given assessment method could provide feedback to the educator and/or the students was considered. Course assignments were designed to meet students at their level of knowledge, experience and skill in the course, while setting the stage for growth and movement forward. This approach challenges students to move toward a more independent and applied learning process (Vygotsky, 1978). Both low and high-stake assessment methods were incorporated into the assessment plan. Low-stakes methods provided valuable informal feedback between the instructor and students while still allowing for formal feedback to students, administration and the institution in the form of grades through higher-stake assessments.

The objective of formative assessments in the course included: gauging student progress in meeting the learning objectives and completing assignment requirements through weekly reflective writing assignments, an assignment in which students designed a needs assessment based on their service learning experience with opportunities for feedback prior to receiving a grade, weekly reflective journals with feedback provided and feedback on their service-learning performance by community partners. An additional purpose of formative assessments included providing immediate and ongoing feedback to the instructor from the students on the service-learning experience to allow for the alteration or adjustment of pedagogy as needed through the use of personal response systems and in-class discussions. Summative assessments were used to provide a final evaluation and grades to students. The summative assignments were an academic poster presentation of their service-learning experience and a final evaluation by community partners. Some assignments were both formative and summative. Students received a final aggregate grade for the reflective journal assignment and the needs assessment assignment.

Low-Stake Assessments

Personal response systems – often referred to as "clickers" – and in-class discussions were used as formative assessment measures in the course to encourage critical thinking and reflection by students. The personal response system provided an easy avenue for anonymous student feedback. The results were anonymous in class, but the instructor was able to review and match responses to specific students at a later time. This process granted the instructor insight into challenges and successes students experienced at specific time points in the course while affording the instructor a chance to address student concerns. Adaptive changes made by the instructor based on student feedback served to create a trusting relationship between the students and the instructor, emphasizing the impact student feedback had on course assignments.

Formal, in-class discussions were scheduled weekly as a low-stakes AfL activity to allow students to construct their understanding of theory and practice (Swaffield, 2011), creating a space for reflection in the classroom. Discussions were additionally valuable for collecting evidence of the learning process and informing pedagogical practices throughout the semester. Discussion topics and talking prompts were planned in advance and revised in an ongoing process to meet student needs. While in class discussions required more time and planning on the part of the instructor they enhanced student learning.

High-Stake Assessments

Using an AfL framework, assignments built upon on each other, culminating in students being able to design and propose a community nutrition needs assessment and program plan. Generally, high stakes assignments require more planning and overall time input by the edu-

cator. Course specific examples of high stakes assignments included intensive reflective writing, a needs assessment planning assignment and a poster presentation illustrating the service-learning experience. To ensure students are learning, opportunities for feedback should be included in the assessment process. While feedback is generally valued by students (Hyland, 2000; O'Donovan et al., 2011) and considered a crucial part of facilitating students' development as independent learners (Evans, 2013; Fergusun, 2011), the actual process of providing meaningful feedback can be difficult for educators given logistics of providing an authentic assessment of student learning with limited instructor time and the potential for large class sizes (Judd and Keith, 2012).

Reflective writing assignments served as an opportunity to provide detailed feedback to students on their service-learning experience, their ability to reflect on that experience and synthesize that knowledge with course concepts and their writing competency. In this course, reflective writing assignments were used to encourage reflection on the service-learning experience, leading students to tie course concepts into their reflections while developing their own writing style. Sampling, or the selection of a subset of students to receive feedback at a given time point, is one strategy for providing feedback to students without overburdening the instructor. In this course, ten students were chosen per week to receive meaningful, in-depth comments on their reflective writing assignments. Of the ten students chosen each week, any student who did not successfully tie in course concepts or use an appropriate writing style were required to revise their reflections based on the provided feedback and resubmit in order to receive credit on the assignment. Students not chosen that week received full credit for turning in a reflection on time.

Feedback given before a final grade is assigned may be more helpful to students than feedback given after an assignment is completed (O'Donovan et al., 2011). In this case, the reflective writing assignments helped students to develop a knowledge base and understanding of community nutrition concepts and practice that was necessary to complete their high-stakes poster presentation assignment. Working in groups, students used their service-learning experience as an anchor. This was the culminating assignment, tying in a needs assessment to a proposed project at the end of the semester with concepts and theories learned throughout the semester. Students expressed some discomfort with the unfamiliar structure and broad criteria of the reflective writing assignment, so the poster presentations, which were given in lieu of a final exam, were very structured. The poster presentation had a formalized rubric so students had a clear understanding of requirements and expectations (Table 2). This formalized rubric was one of many adaptations made during the semester in response to student feedback.

Inclusion of Community Partners in the Grading Process

The purpose of including service-learning as a course assignment was to create space for students to learn about community nutrition within community settings from community practitioners. Community practitioners took on the role of community-based educators showing students practical aspects of community nutrition. This type of community-based learning was an explicit goal of this course, hence it was logical to ask community partners to provide input on student grades. Instead of having students log their service-learning hours for accountability, community partners evaluated students in a formal capacity upon completion of their required 20 hours of service. Community partners also provided qualitative feedback to students on their performance that addressed student competencies.

Community partners, along with other faculty members from The Department of Human Nutrition, Foods and Exercise and VT Engage, were also invited to the end of course poster presentation session, which served to showcase the culmination of the semester experience by presenting their plan for a community nutrition educa-

Table 2. Poster presentation evaluation rubric for Community Nutrition.

Criterion Measured	Capstone Points 23-25	Milestones Points 20-22	Milestones Points 18-19	Benchmark Points ≤17	Points Earned
Communication *Oral and Written Communication of Context, Perspective and Central Message*	•Thorough understanding of context, audience and purpose of service-learning site •Articulates a compelling and innovative central message	•Adequate understanding of context, audience and purpose of service-learning site •Clear central message	•Awareness of context, audience and purpose of service-learning site •Basic and/or understandable central message	•Minimal attention to context, audience and purpose of their service-learning site. •Central message is deducible but not explicit	
Critical Thinking *Explanation of Community Need*	•Considered critically, stated clearly and comprehensively •Delivered all relevant information	•Some omissions of community need •Understanding is not seriously impeded by omissions	•Description leaves some terms undefined and other ambiguities	•Not considered critically •Stated without clarification or description	
Intercultural Knowledge *Knowledge of cultural worldview frameworks*	•Sophisticated understanding of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices	•Adequate understanding of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices	•Partial understanding of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices	•Surface understanding of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices	
Civic Engagement *Civic Context and Structure*	•Demonstrates ability and commitment work collaboratively in community for a civic aim	•Demonstrates ability and commitment to work actively in community for a civic aim	•Demonstrates experience identifying ways to participate in civic contexts and structures	•Experiments with civic contexts and structures	
Total Points					/100

tion program based on their service-learning site needs assessment. The poster presentation evaluation rubric (Table 2) was also designed to incorporate community partner and stakeholder perspective and feedback into grading the presentations. The poster evaluation scores were then averaged for each student group to calculate the final grade for the poster presentation. Incorporating community partner feedback and establishing clear roles for participation in the service-learning experience for students, faculty and community partners enhances the opportunity to create real world experiences and clarity of employer expectations before undergraduates enter the workforce.

Conclusions/Implications

The assessment plan for this course serves as an example of one approach for assessing student learning, providing ongoing feedback to the instructor to allow for adaptation of pedagogical practices, and providing a framework for assigning grades to students. The assessment plan, which included a variety of methods that met the needs of the instructor, the students, the community partners and the institution to meet accreditation requirements, was a logical approach for a community-focused class comprised of 38 students. The same approach may not be applicable to courses with larger numbers or those without a community focus. However, many assessment methods exist that could be used to meet the needs of educators of varying course subjects and class sizes. Suggestions are provided in Table 3.

Different approaches to assessment of service-learning can be chosen based on the educators' and students' needs. The above mentioned table offers suggested assignments that may be appropriate for a variety of settings and which can be used to overcome several logistical considerations including available time for in-class activities, creating a manageable workload for grading assignments with or without a teaching assistant, high student to educator ratios, the educational level of students and the need to develop other necessary skills (e.g. writing, effective communication, etc.). In this specific course, learning objectives were aligned with the Association of American Colleges and Universities (2015) VALUE Rubrics for authentic assessment of student learning that included assessment criteria for oral and written communication, critical thinking, cultural sensitivity/intercultural knowledge and civic engagement. These criteria aligned with accreditation requirements for Nutrition and Dietetics programs, development of communication skills to transfer knowledge, cultural communications, written and verbal communication skills, knowledge of determinants of health and diversity, critical thinking and cultural care (ACEND, 2015).

By intentionally switching to an AfL approach, educators can ensure their assessment strategies not only guide education practice but also serve as a way for institutions to demonstrate their proficiency in meeting the needs of accreditation bodies, such as ACEND. A structured, multi-faceted assessment approach to assessing student learning provides educators with a feasible strategy to demonstrate their effectiveness and impact in meeting learning objectives set forth by accrediting bodies while providing valuable and desired feedback to students.

Table 3. Various assessment methods that can be used to meet the needs of educators based on class size and course subject.

What	How	Why
Prior Knowledge Self-Assessment	Ask students to reflect and comment on their level of: • Knowledge • Skills • Experiences	• Prerequisite to your course • Valuable but not essential to the course • Addressed in the course
Observations	Short notes written on: • Notebook • Sticky notes • Note cards	• Picture of student learning over time • Adjust instruction based on student needs
Discussions	Ask good questions: • Explore issues • Ask open ended questions • Online forums • Check in with each student or student group • Small groups	• Foster dialogue/enhance student learning • Insight into the depth of student understanding • Develop critical thinking skills
Ticket-out(in)-the-Door	• Student response to a question on a notecard • Turned in when leaving or entering the next class session	• Insight into the depth of student understanding
Minute Paper	• Post open ended question • Students have 60 seconds • Share on volunteer basis	• Insight into the depth of student understanding • Starts the class discussion
25 Word Summary Assignment for class readings	• Write a 25-word summary that captures the authors purpose • Students turn it in at the beginning of class- share on a voluntary basis	• Insight into the depth of student understanding
Journal	• Blogs • Scaffold reflective writing assignments • Give descriptive feedback	• Capture student learning as a process • Students formulate questions/make connections • Develop critical thinking skills
Think-Pair-Share	• Students pair to discuss topic • Share main theme with class	• Insight into the depth of student understanding • Students formulate questions/make connections • Develop critical thinking skills • Peer Learning
Think-Pair-Square-Share	• Students pair to discuss topic • Share with neighboring pair main theme of discussion • Share main theme with class	• Insight into the depth of student understanding • Students formulate questions/make connections • Develop critical thinking skills • Peer Learning

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Expectations and Experience: An Exploratory Study of Undergraduate Research Experiences as Viewed through the Experiential Learning Theory

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Abstract

Undergraduate research is a growing component of agricultural communications programs across the nation. Students draw upon their constructed experiences with research to assign the level of personal significance in their own lives and future career aspirations. This qualitative exploratory analysis investigated the experiences of four undergraduate students majoring in agricultural communications at a Mid-Western Land Grant University as they completed an on-campus undergraduate research class or experience. Participants identified research had a positive impact on the field of agricultural communications, but only the students who participated in a small, self-guided research class had a positive viewpoint toward research. All participants identified undergraduate research projects as beneficial and mentioned a desire to be recognized for their work by presenting at small-scale, on-campus research events. This study was guided by the experiential learning theory and recommends research mentors provide a positive emotional experience throughout the research process in order to allow students to construct positive associations and meanings to research.

Keywords: Undergraduate Research, Experiential Learning Theory, Expectancy Violations, Qualitative, Agricultural Communications

Introduction

Undergraduate research experience (URE) is defined as "an inquiry or investigation conducted by an undergraduate that makes an original intellectual or creative contribution to the discipline" (NSF, 2003, p. 9). Although faculty may be apprehensive about implementing UREs within their department due to a lack of resources (time, funding and availability of dedicated students), the benefits far outweigh the costs (Lei and Chuang, 2009). Undergraduate research experiences can help student increase their retention in subject matter ("CUR At-a-Glance | Fact Sheet | Council on Undergraduate Research," 2011), enhance the undergraduate experience, help focus on achieving sought after goals (Sabatini, 1997), increase student levels of knowledge acquisition and improve the perception that research can be a positive and relevant experience (Willis et al., 2013). Students also experience a transformational shift in learning styles. The higher level of independence a student experiences in their research experience, the more they learn (Nadelson et al., 2010). Furthermore, students exhibit a transition from a dependence on their advisers, to becoming true researchers and autonomous problem solvers (Rauckhorst et al., 2001).

Hunter et al. (2007) found a correlation between conducting research and an increased level of confidence in students' ability to think critically and conduct research. The biggest boost to student confidence was taking part in research that was relevant and beneficial to their field. In creating research that can positively impact their field, students gained an increased clarity in career direction, specifically toward employment in research fields (Hunter et al., 2007). When undergraduates create meaningful research they develop an increased feeling of community and sense of belonging within their department and academic field (Howitt, 2010).

Faculty Role

Benefits resulting from UREs could not be possible without the direction of a supervisor, whose role is critical (Russell et al. 2007) and is the largest factor determining the success and satisfaction with the student's URE (Howitt, 2010). Students generally enjoy the opportunity to work with an adviser in a one-on-one setting because such experiences develop a heightened com-

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munity and collegial relationship with their advisers or mentors (Seymour et al., 2004). The interactions and direction of the supervisor guides not only the students' expectations of the experience but also their satisfaction with the program. As such, students prefer supervisors that make them feel prioritized, are organized, and trustworthy (Howitt, 2010). Supervisors must realize a large part of the success of the student experience hinges on defining clear expectations and clearly defining precise and obtainable goals (Howitt, 2010). Faculty agree with students that the research topic and its ability to positively impact the field is of high importance but faculty tend to place a higher value on UREs than students do (Dahl, 2013).

Expectancy Violations Theory

The Expectancy Violations Theory (EVT) is based on the premise that interactants (any person engaged in communication) do not perceive a given interaction between individuals as random and will respond to behaviors in varying levels based upon whether their expectations for that interaction have been positively or negatively violated (Burgoon, 1978). When an interactant's expectations are positively violated, she will hold positive psychological reactions toward that experience. Conversely, when an interactant's expectations are negatively violated, negative psychological reactions occur (Le Poire and Burgoon, 1996). Furthermore, positively-violated expectations can lead to higher levels of attention toward a task or message and greater learning (Le Poire and Burgoon, 1996).

When viewed through the context of the classroom, student attitudes toward an assignment, exam, or topic can be highly influenced depending on whether their expectations have been positively or negatively violated (Houser, 2006). Therefore, when a student encounters positively-violated expectations, she may view the subject matter, assignment, or experience in a higher esteem than when her expectations are negatively violated. Although expectations are important, individual experiences carry a higher degree in course evaluation and perception than prior expectations (Houser, 2006).

Students have specific expectations they place on the classroom and instructor (Houser, 2006; Koermer and Petelle, 1991). Additionally, students expect instructors to practice clear communication on all tasks and provide ample guidance with assignments or projects (Houser, 2006; Koermer and Petelle, 1991). Since tenants of the EVT can impact students' perceptions toward the instructor and influence whether the student has a positive or negative emotional response toward the material being offered in the classroom, educators can draw upon the EVT to understand how their communication may affect instruction (Houser, 2006). Since so much hinges on the effectiveness of the supervisors and expectations held by the student, understanding the expectations of both parties has implications into the perceived learning and enjoyment of the experience (Kardash, 2000). Little is known about EVT in connection with URE's.

Experiential Learning Theory

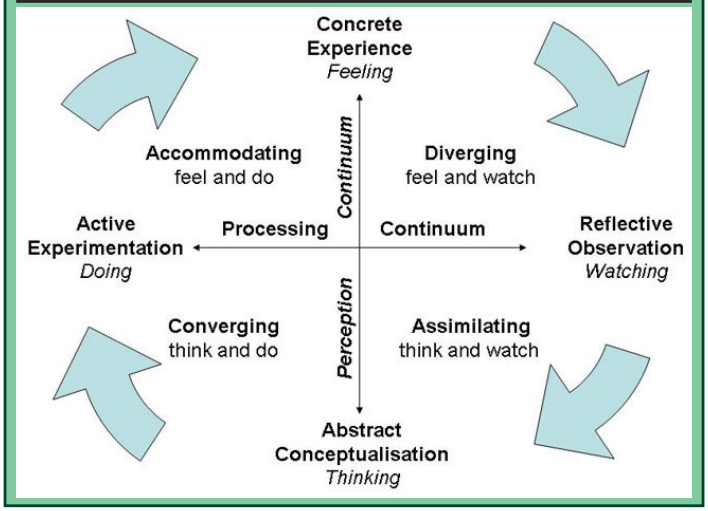
Kolb and Kolb (2005) define learning through the Experiential Learning Theory (ELT) as "the process whereby knowledge is created through the transformation of experience" (p. 194). The ELT includes six propositions: 1) Learning is not an outcome but a process, and therefore feedback should focus on the student's learning process and effectiveness of their efforts; 2) Relearning and restructuring student beliefs about topics in order to test assumptions with new ideas is a primary factor in learning; 3) the process of learners adjusting to conflict and resolving such conflict drives the learning process; 4) learning cannot be limited to the increase in knowledge but must also include 5) the interactions between the learner and the environment to which the understanding occurred; 6) learning is viewed from a constructivist viewpoint and includes the process of creating knowledge and learning through a dialectical process facilitated by conversation (Kolb and Kolb, 2005).

Experience plays a central role in the perceived outcomes of the learning process, and that experience is what differentiates the ELT (Kolb et al., 1999). The ELT places specific emphasis on the process and educational experience of the learner. Furthermore, learner experiences, whether negative or positive, can be the key determinant of achieving the educational objectives of the learning activity which can, in turn, influence the student's perception of obtained knowledge (Kolb and Kolb, 2005). A student who finds difficulty assimilating into a learning group or has a negative experience will construct negative associations with that experience, thereby altering the perception of that event. Therefore, teachers and professors must consider the social environment and quality of relationships that help foster the learning atmosphere in addition to the educational objectives. Student experiences and value of research experiences can be enhanced through creating an atmosphere and environment that promotes positive experiences of learning (Kolb and Kolb, 2005). Kolb and Kolb (2005) describe learning as a continuous process that is demonstrated in a conceptual model that involves two factors: 1) the preferred approach or learning style to a task; and 2) the emotional response to the learning process (Figure 1). Faculty can draw upon these two factors to guide students throughout the learning process of a URE's.

Purpose

Although many studies have been conducted on undergraduate research, the body of literature is concentrated on the hard sciences (engineering, chemistry, biology and physics) and neglects social sciences, specifically the field of agricultural communications. The purpose of this study was to explore the experiences of agricultural communications undergraduate students enrolled in an autonomously structured-research course and those enrolled in a classroom-based research class. Researchers sought to understand how each of these experiences shape a student's knowledge and attitudes

Figure 1. Kolb's Experiential Learning Model



toward research, the value they placed on the educational experience, and the experiences vs. expectations of the research process.

Methods

A qualitative approach was deemed appropriate for this study, because qualitative research seeks to gain an in-depth and complete understanding of a topic (Creswell, 2014) that persists outside of the researcher's paradigm (Williams and Heikes, 1993). Qualitative research is inclined to utilize purposive sampling measures where participants are selected based upon specific criterion (Creswell, 2014). The data collection method was in-depth interviews with participants. An interview at its core is an interaction between two people (Yeo et al., 2014). The interview technique of data collection makes participants more apt to divulge information, yielding in-depth and rich data (Creswell, 2014).

Prior to the study, the research team established criterion for participant selection that would draw from two research classes taken by agricultural communications students. Class A was an agricultural communications research class with low student-to-teacher ratios that focused heavily on the process and experience of research. Although two instructors within the department teach Class A, to eliminate any instructional bias, only students from one professor were included in the study. Class B was taught in the school of journalism and was a traditional lecture-based class with a high student-to-teacher ratio. Students in Class B experienced mass communications research through class lectures and a group research project. Half (n=2) of the participants were selected from Class A and half (n=2) were selected from Class B. Since a history bias could also generate a variance in responses and limit transferability of this study, an attempt was made to include students who had completed the class within one calendar year. Gender is an additional bias because although advisers show no bias in rating gender, male students tend to rate their research abilities significantly higher and view a higher increase in abilities than their female counterparts (Kardash, 2000). In light of this potential bias, students were matched by gender according to enrollment. These two criterion resulted in all female participants which closely resembles the gender breakdown of the program.

Students with higher grade point averages (GPA's) could place an increased emphasis on research than students with a lower GPA. Students with higher GPA's might have an increased desire to obtain a graduate or professional degree and hold research in higher esteem than students with lower GPA's. Once students from Class B were sampled to match the history and gender of the Class A students, GPA was used to further hone the selection. Students were first matched based upon the grade they received in their research course with the rational that students who received a higher grade in the course would have differing opinions of students who received lower merits. Students were further culled based upon the closest GPA match. No effort to match students by race was conducted since ethnic identity bears no statistical difference in rating of experience, intentions toward graduate school and satisfaction with the quality of supervision (Lopatto, 2007). The aforementioned selection criteria yielded a field of eight possible participants of which four agreed to participate in the study.

An undergraduate student was used to recruit participants and conduct the interviews so students would not feel threatened. Additionally, researchers thought students would be more open and honest with a peer than someone at a higher level with ties to the program. A 12 question interview guide that included additional prompts was agreed upon by a panel of experts and approved by the Kansas State University Institutional Review Board. Prior to the interview starting, partici-

Table 1. Characteristics of Participants

Name	Class/Status	Participant Description
Anna	A Senior	Anna is a member of the University Honors program and is required to conduct a research project as part of this program. Her adviser recommended the class as a way to fulfill that research credit. She expected to work closely with the adviser and have a rigorous workload. She had a specific idea regarding what she wanted to research and presented her research poster at two different events. Anna plans on getting her law degree.
Bethany	A Junior	Bethany was encouraged to take the class by her adviser and her employer who also worked on campus. She describes herself as self-driven and expected a rigorous workload. She expected hands-on research and close supervision from the adviser. Bethany had a specific idea regarding what she wanted to research and presented her research poster at a College of Agriculture event.
Cassandra	B Senior	Cassandra took the class because it is a required course to graduate. She took a modified 8-week class over the summer to "get it out of the way". She expected a small level of feedback from her professor. Cassandra did not conduct an individual or group research project but was exposed to research through classroom lectures.
Diana	B Senior	Diana took the class because it met a graduation requirement She expected it to be a rigorous course with ample contact and feedback from the professor. She conducted a group-research project but did not present her work.

pants signed consent forms and were given a confidentiality agreement. A description of the students is listed in Table 1. Participants were debriefed immediately after the interviews which were recorded and transcribed. NVivo 10 was used to facilitate categorizing responses into codes and categories in order to generate appropriate themes using Glaser's (1965) constant comparative method.

Limitations and Delimitations

Although every effort was made to match student history between Class A and Class B, the students of Class A had completed their research class in the previous semester while one of the students of Class B completed it two semesters ago. A potential history bias could arise, especially in regards to knowledge of research. Secondly, one student from Class A had already had some experience with conducting research. Her attitudes and experiences regarding research in agricultural communications could have been influenced by situations and phenomena outside the timeframe or focus of this study.

Results

Emergent coding of participant responses generated two themes that helped answer the guiding question of this study: 1) Although all students believed research impacts the agricultural communications profession, students with self-directed, hands-on research projects had a greater appreciation for and understanding of research; 2) Students desired recognition for research projects that can be achieved through presenting their work.

Theme 1: Although All Students Believed Research Impacts Agricultural Communications, Students with Self-Directed, Hands-On Research Projects Had a Greater Appreciation for and Understanding of Research

Within this theme were three sub themes of: topics were important; knowledge and appreciation of research; research positively impacts the field but personal impacts may vary.

Topics are important

When students were asked to describe their research project, three out of four students started describing their level of interest in the topic and how that influenced their motivation and satisfaction with the class. One student, Cassandra, did not complete a research project due to the shortened summer schedule. Diana (Class B), who did not value the experience and was enrolled in the traditional research class, stated:

"We picked a random topic which I think ours ended up being Puma vs. Adidas shoes and what influenced people to buy one or the other. That's what we ended up with. One of the guys was into soccer, so that was it. [*I would have valued the experience] if I would have gotten to do an interesting research project. I think if it's interesting and, if I had something interesting to do research on something that was going to matter to somebody, I think it would be great."*

While Diana's experience with a less-than-desirable research topic elicited a negative response, Anna and Bethany, who were both enrolled in Class A, spoke highly of the freedom to research what they wanted. Although Bethany had to change her research project mid-course due to issues beyond her control, she talked positively about her topic, saying: "*You don't have a professor telling you what to go learn about, that's your choice. You are given the opportunity to learn about what you want to learn about and that doesn't happen very often."*

Unlike the other students in the study, Anna had previous experience with research through her work with the University Honors Program. Anna mentioned her passion for a specific topic that guided her research and how the topic was a positive attribute of Class A. "*I knew I wanted to do something with crisis communications, and I love the milk company that I did my project with. I feel like you have to have an idea for your project planned when you come into the class. A common misconception is that you can just take the class like any other regular class. I feel like you have to kind of already know what you want to do with your project and like kind of already have a direction that you want to go with."*

Cassandra was enrolled in an accelerated summer research class, and although she did not express negativity toward not conducting a project, she did have an expectation of completing one. "*I thought we were going to do a specific project. But he explained that since it was a summer course, we couldn't… we didn't have the time and it was a small group of people, so we didn't have a lot to work with in terms of doing a project. So, it was different than I thought it was going to be."*

Knowledge and appreciation of research

Students who completed the self-directed Course A also seemed to have a fuller and deeper understanding of the research process and satisfaction. Since the purpose of research classes is to help students gain an understanding of research methods, students were asked to tell the interviewer what they knew about research. The literature review process was a point of emphasis for Anna and Bethany, although Cassandra also mentioned the need for secondary research.

Regarding the literature review, Anna said *"You're going to set your objectives and then you're going to do your background research of your literature review to figure out like what has already been accomplished or what has already been said and done about the topic."* Bethany gave additional clarification to the literature review process: "*You also want to do a literary assessment. You want to search all the different aspects of your topic that could be included in your research to figure out what's already been done. So one, you don't repeat and two, you can see what is and isn't working so you can see…kinda map out your methods for your research."*

Cassandra did not conduct a research project but mentioned the process of a literature review in her response, saying "*You have to look at studies that have already been done and what their outcome was, and you would compare your study outcome to theirs and see if it is consistent".* Although Diana took the same class and the same teacher as Cassandra, she did have a research project with a topic and group that she expressed dissatisfaction. Diana stated "*I don't know much about research*." When asked what she knew about the process of a literature review she responded*, "Not much".*

Students also recognized, to a varying degree, the need for designing a methodology of a study. Diana (Class B) stated, *"I know we learned about different methods, but I don't really know what they were or what they do for me. I learned analyzing data is important and conclusions are also important."* Anna (Class A) alluded to methods of research, saying: "*There is quantitative and qualitative research…Once you have your topic, then you have to figure out like what your research question is going to be. In terms of setting your objectives, and then your objectives determine where your projects going to go from there. You're going to look and set your goals and you're going to figure out exactly how you're going to answer your research questions that you've set after you look what else…what else has already been done. Then you need to figure out your data and methods in terms of human subject forms…you have to get approval in terms of all that kinds of stuff. After all that is completed, that's when you finally collect your data. Then you start analyzing your data depending if you have qualitative or quantitative analysis depends on if you're working with numbers of working themes and code books. You're going to analyze your data and then set your conclusions and figure out what you've learned from your study."*

Although Cassandra (Class B) did not conduct a research project. Her responses were more isolated to the realm of choosing appropriate sampling measures, saying: "*Pick a target audience…specific questions or topics you want to know from and come from an unbiased point of view. Random selection is important, but it's not random, you cannot call it random. A good sample pool of people is needed to get a correct analysis, so choose your audience specifically. For example, you might want to target producers, but you might need to figure out if you want to target producers in Kansas, and is it just farmers or is it ranchers, or both."*

Bethany's (Class A) study utilized a survey in her URE and her responses indicated an importance in testing the validity and reliability of the research instrument. "*You would want to draft a survey, if you wanted to survey and you want to figure out if you're thinking qualitative or quantitative or mixed methods that will help you draft your survey. Run test surveys before you actually get your real survey out there and you want to see what would be the best group or way to run your survey."*

None of the students interviewed were prompted to answer questions about data analysis or transferability and generalizability. However, all students mentioned some level of analysis in their responses. Diana mentioned *"I learned analyzing data is important. Conclusions are also important and sometimes difficult especially when you have different groups of people."* Cassandra (Class B) gained some experience with quantitative data analysis, saying: "*We learned how to put data into a spreadsheet and divide it up into answers, or you know, how to break it down so it is easier to read. You have to say why we did it, whom we were trying to teach, and what the outcome was. The whole process. I can say I learned a lot from this class."*

Anna (Class A) also mentioned data analysis and the importance of drawing conclusions, implications and recommendations for future research. While finalizing her response to her knowledge of research prompt, Anna discussed the importance of analysis: "*You're going to analyze your data and then set your conclusions and figure out what you've learned from your study. The last part is just figuring out like what implications that has for the future and what implications that has for the industry as a whole. The last thing you do is write some recommendations or some things that if someone else were to copy your study how would you change or improve it to make sure that research is continuing to move forward. Then you present it. I've learned a lot in this class."*

Bethany (Class A) included the need to expand upon research. "*You need to analyze your data and make conclusions of your data in comparison to the research that you've done. You want to analyze your whole research project…How does it relate to previous research? How to expand on the research?"*

Research positively impacts the field, but personal impacts may vary

In regards to the impact research has on the agricultural communications profession, Diana (Class B), says *"It obviously adds knowledge and perspective to different areas in agricultural communications. I think it's really important, and I think if it's done right it is very helpful and beneficial."* Anna (Class A) and Bethany (Class A) both mentioned research helps communication with the industry. Anna stated: "*Each study has implications of some sort whether that be… a more detailed crisis communications plan or understanding that local businesses have an easier time communicating with the media. Each study has an implication that can be used in the future."*

Bethany's response indicated research allows producers to better communicate, and said *"They [producers] may not be able to communicate…Agricultural scientists and producers don't know how to communicate to the rest of the world…there's a break in communication… [research] would break down barriers."*

Participants also constructed various meanings of research based on their research class and projects.

Although all students were required to take the research class, they did not have to participate in an individual research project. Anna and Bethany (Class A) both had an interest in a research topic prior to their class and had a positive experience with research. Anna plans on attending professional school in the near future, and when asked about how research impacts students, she stated *"It depends on what career field the student is going into. If they want to do any type of schooling or graduate school after, I feel like it's a really good experience."* Bethany also mentioned a possibility of graduate school afterwards, saying *"I feel like I want to do more research in the future. I would consider doing more research if I get my master's degree too"*. However, Cassandra and Diana (Class B) both had more neutral to negative viewpoints of conducting research and how it impacts their lives. Cassandra said *"I don't think [conducting URE's] impacts my viewpoints on research a lot",* while Diana said *"It made me want to never, ever do research again in my life."*

Theme 2: Students Desire Recognition for Research Projects that can be Achieved Through Presenting Their Work

One common theme that developed was the desire for receiving recognition for the hard work associated with a research project and how presenting posters can offer such recognition. Class A required the students to present their research in a form of a poster while Class B did not. Diana, who took Class B stated *"I think it makes you more comfortable. You can present something that you learned and you can learn from it, other people learn from it. It's important. I would have benefited from it."* Cassandra also took Class B, and mentioned "*undergraduate students don't have the platform to share their work, graduate students do. If you work hard enough on something you'd want to share it…You'd want others to see how hard you worked."*

Students who presented undergraduate research had similar attitudes. Anna (Class A) mentioned, *"Presenting my poster…has been a really cool experience... If you didn't present your research no one but you and your adviser would even know that it was completed."* Bethany gave further praise for the necessity of undergraduate presentations, stating *"At first I didn't because I didn't want to. I was timid. I think it's really important. It gives them experience, helps them understand the process and get confidence."*

In regards to a place or an event to present research, participants preferred a smaller, more intimate setting that is on campus for their first research presentations because they can be intimidating. Anna stated *"I think it would be cool to have a university-wide fair as well as a college-wide one…So I think it's cool to have one across the university and one for the college." "Definitely on campus",* Anna said. She continued, *"You're connecting to other researchers; so you're networking and connecting with professors. I really liked that events were really small and not too big of a deal. There wasn't a lot of people there, so it made me less nervous."* Cassandra (Class B) mentioned presenting research on campus in a casual, non-intimidating setting would be preferred, saying *"Maybe during Open House, you know, set up a table where they can present things. If it was, you know, in the union or something, where people were walking by and they can share it just kind of as people were walking through and were interested."*

Discussion

Participants who were allowed to select a topic of interest to research maintained more positive views toward research while students who were enrolled in the autonomous Class A appeared to have a deeper level of cognitive understanding and appreciation of the research process. Anna and Bethany's (Class A) narrative was consistent with the findings of Willis et al. (2013) stating that students who have deeply personal and independent research experiences foster a greater understanding of such methods and often attach a higher meaning to the process. Participants from Class A identified having some degree of positively-violated expectations which may have increased their cognitive acquisition and helped foster positive viewpoints toward research. Conversely, participants from class B mentioned the class was not what they were hoping for and therefore had negatively-violated expectations which could have led to decreased long-term understanding of research and less-than-favorable viewpoints toward the topic.

One of the biggest connections to past research comes from the confidence the students described they acquired through this experience, particularly in presenting research. This is congruent with the findings of Hunter et al. (2007), which stated student confidence is boosted when students take part in research that is relevant and beneficial to their field. Students of Class A were allowed to pursue research topics that held personal meaning and interest. This finding could also draw upon and add to Kolb and Kolb's (2005) model of the ELT which states learning includes an emotional and pedagogical component. Students who investigated topics that carried significant personal meaning or attachment would enter the learning experience along a positive emotional continuum, thereby preemptively associating the research experience through a positive lens. Anna and Bethany (Class A) drew upon their positive emotional experiences to construct a positive and relevant meaning toward research. Diana's lecture-based (Class B) experience contrasts both students of Class A, and her negative experience parallels Kolb and Kolb's (2005) findings that students with difficult experiences will construct negative associations toward that experience. Cassandra (Class B) remained neutral toward research, possibly because she had no personal experience to draw upon when constructing a meaning toward research.

Students expect teachers to provide clear, immediate, and thorough communication that more than equips

them to complete assignments (Houser, 2006; Koermer and Petelle, 1996). Since students expect close and constant supervision from instructors, the nature of large-scale research courses could potentially be leading to negatively-violated expectations from students embarking upon a complex and challenging topic like research. A potential recipe for negatively-violated expectations could instill a negative context or connotation toward research in the minds of students. This would align with the findings of Houser (2006) who stated instructors are negatively violating student expectations for URE's.

Implications and Recommendations

This study offers implications for faculty and staff that have research appointments and teach undergraduate research courses. Every effort should be made to offer clear expectations to the students and offer a positive research environment full of opportunities for dialogue. Faculty should be cautious on "over promising" and "under delivering". Students will accept setbacks and still have a positive experience, as demonstrated with Anna in this study, as long as students are prepared for potential setbacks. By facilitating a positive experience for undergraduates, faculty members will allow students to view learning and processing through a positive emotional continuum that will help construct positive associations toward research. Students' perceptions of experiences could have been influenced by the difference of Class A being taught in the College of Agriculture and being specific to the students' major. Therefore, students were likely more interested in the experience. This demonstrates a need for URE within students' majors or at the very minimum within their college.

Participants had a considerable time commitment to their research projects and desire opportunities to showcase their work beyond a paper submitted to their professor. Therefore, students should be encouraged to present their research in small-scale, on-campus events in order to gain recognition for their work. This conclusion supports the creation of undergraduate research showcases on college campuses. By receiving sought-after recognition, their experience will be further validated which could in turn move the students toward a positive emotional response to the experience. Such positive emotional shifts could also validate the research process as a whole and thereby allow the student to construct positive viewpoints toward the research process. This research supports offering experiential learning experiences to agricultural communications students through URE's.

This research offers additional questions regarding how the EVT influences the experiences and perceptions of students participating in undergraduate research courses. Although Houser (2006) stated experiences are more important than expectations, how experiences relate to student expectations is a major area of focus for the EVT. Additionally, student experiences will ultimately be judged by the expectations they have for the course content and their interactions with the professor. Therefore, it is recommended that instructors adopt Houser's (2006) recommendation of using the EVT to evaluate their teaching and communication styles and determine how those efforts align with the desires and needs of students. Furthermore, instructors should make every effort to clearly define the scope of the class they teach, what it will entail, and how students will be evaluated. Since students evaluate their instructor in regards to how they communicate and the level of help they will give, instructors should make every effort to establish clear expectations for how they plan to communicate with students and offer help on class assignments, projects, or exams.

Further research should be conducted to identify how the emotional experience of undergraduate researchers defines the research process and the relevancy of such research to the individual student and their career aspirations. Additionally, research should be conducted to identify how undergraduate research classes can be structured to maximize the learning experience along both emotional and pedagogical continuums based upon Kolb's model (Figure 1). Researchers recommend following this qualitative research with a large-scale, national, quantitative study focusing on how the ELT shapes students' experiences, attitudes and viewpoints toward URE's.

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A Student-Driven Nutritional Biochemistry Recitation Course Demonstrated Better Grades and Acceptability among Enrolled Students

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Abstract

To determine the acceptability and effectiveness of a student-driven recitation course in enhancing student learning of nutritional biochemistry, student data derived from upper-level dietetics and human nutrition majors was compared between those enrolled in the required three-credit hour lecture course only (n=84) and those enrolled in the lecture plus optional supplementary one-credit hour recitation course (n=89). Both lecture and recitation were led by the same course instructor. Recitation students were required to post questions to the recitation course wiki, which the instructor used to generate discussion and further questions from the students during recitation. Results demonstrated that final course grade averages were higher among students enrolled in recitation, 83.5% ± 10.1 vs. 78.8% ± 11.7 ($p< 0.05$) and attendance was better, 6.2 ± 1.2 vs. 5.6 ± 1.4 days (7 random attendance days, $p< 0.001$). Over 70% of students found recitation to be helpful or very helpful in clarifying class material and preparing for course exams ($p< 0.001$). Two-thirds of students stated they would recommend recitation to a peer. These positive results indicate the student-driven recitation was delivered appropriately to meet student learning needs in a manner that required minimal course preparation by the instructor.

Introduction

Challenging science-based coursework such as advanced courses in biology, chemistry, physiology, genetics and biotechnology are common requirements in undergraduate agriculture disciplines. In dietetics, animal science, food science and human nutrition programs, nutritional biochemistry is often considered a difficult course. Such rigorous science-based coursework can challenge and intimidate students, perhaps contributing to under-performance and a tendency towards memorizing, rather than truly learning, important concepts (Minasian-Batmanian and Lingar, 2006). Indeed, starting in elementary school, children often have a difficult time grasping the application of biology and chemistry (Carvalho et al., 2004). This is particularly the case in nutrition where students are expected to relate biochemical pathways occurring as the result of food intake to subsequent health implications, such as diabetes or obesity (Rowlands, 2004).

This research study aimed to evaluate the acceptability and effectiveness of an optional one-credit hour student-centered recitation in a high (n= 173) enrollment undergraduate course. While others have evaluated a wide variety of innovative approaches to teaching biochemistry, limited research is available on the acceptability and efficacy of a student-driven recitation or workshop. This study is unique in that (1.) the lecture instructor was also the recitation instructor and (2.) the material discussed during recitation was student-driven in that it was based on student questions posted to the course wiki prior to class rather than the instructor providing in-class worksheets or reviewing homework problems. This manner of delivery required little preparation time for the instructor while focusing on challenging concepts as perceived by students. Knowledge gained from this study could be utilized in making decisions about allocation of resources (i.e. faculty time) in teaching challenging coursework. Indeed, while many innovative classroom approaches prove successful, some are too resource intensive to sustain (Anderson et al., 2005).

Methods

Study subjects (n=173) consisted of junior and senior students enrolled in a three-credit hour undergraduate nutritional biochemistry lecture course that was required for human nutrition and dietetics majors.

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The one-credit hour nutritional biochemistry recitation course was an optional supplementary course open to all students enrolled in the lecture. Two comparable sections of recitation led by the course instructor were offered one day per week (n=43 and n=46 students). Each week, two students were assigned to post a minimum of one biochemistry-related question to their respective recitation section wiki, which was available through the course learning platform. As well, all recitation students had the opportunity to anonymously post questions to their respective recitation wiki at any time throughout the semester. At all times during the semester, the posted questions were available for viewing by students enrolled in recitation. The course instructor started each recitation class by displaying the posted wiki questions on the screen and initiated discussions by probing the class to answer each wiki question along with other questions that were raised during recitation.

At the end of the semester, all students in the nutritional biochemistry course were invited to earn bonus points by taking an online anonymous survey. The survey included 22 questions pertaining to their study habits and if applicable, satisfaction with the delivery style of the student-driven recitation in enhancing their learning of lecture material, clarifying class material and preparing them for exams. A total of 168 surveys were completed, which included 88 students enrolled in recitation.

To assess student learning between those enrolled and not enrolled in recitation, final course grades were compared. Course grades were calculated based on averaging four exams and four online quizzes. Random in-class attendance was taken in lecture seven total times throughout the semester and was compared between groups.

The human nutrition and dietetics students enrolled in the fall nutritional biochemistry class were required to take the follow-up advanced nutrition course. Therefore, to evaluate retention of macronutrient metabolism knowledge, the exam 2 grades from the follow-up advanced nutrition course (spring 2015) were compared between students enrolled and not enrolled in the biochemistry recitation the previous semester (n=140 students). Exam 2 material covered the application of macronutrient metabolism that was included in detail in the pre-requisite nutritional biochemistry course (fall 2014). The University of Kentucky Institutional Review Board approved the study protocol and all participants provided written informed consent prior to participation in the study.

Data was analyzed using SAS version 9.3 (SAS Institute Inc., 2012). Descriptive statistics including means, standard deviation and frequencies were calculated for all students enrolled in the required nutritional biochemistry class, those enrolled in recitation, and students in lecture only. The Shapiro-Wilk test for normality revealed the data to be normally distributed (p> 0.05). Significant associations between continuous variables (course grades, cumulative GPA, and attendance) were determined using independent student t-tests. Chi Square analysis was used to determine significant associations among categorical variables. Significant correlations among the variables were identified using the Spearman correlation test. The General Linear Model multiple regression analysis was used to delineate the relationship among course grades, cumulative GPA and recitation. Final course grade was the dependent variable and cumulative GPA and recitation enroll-

Table 1. Descriptive Statistics of All Students Enrolled in a Required Nutritional Biochemistry Lecture Course.

	All Students in Required Lecture Course (N=173)	p-value[z]
Major (%)		***
Dietetics	39.9	
Human Nutrition	56.6	
Other	3.5	
Enrolled in Recitation (%)		
Cumulative GPA (SD)[y]	3.21 ± 0.4	
Mean Final Course Grade (Grade ± SD)	81.2 ± 11.1	
Course Grade Distribution (%)		***
A	23.7	
B	35.3	
C	26.6	
D	11.6	
F	2.89	
Mean Random Attendance (Days ± SD)[x]	5.91 ± 1.3	
Random Attendance Distribution (%)		***
0 – 1 days present for random attendance	1.73	
2 -3	4.05	
4 -5	23.7	
6 – 7	70.5	
Mean Exam 2 Grade from Advanced Nutrition Course (n= 140, Grade ± SD)	76.6 ± 13.7	
Advanced Nutrition Exam 2 Grade Distribution (%)		*
A	22.9	
B	25.7	
C	23.6	
D	12.1	
F	15.7	
Do you study by yourself or with a group?		***
Mostly with a group and some on my own	13.7	
Mostly on my own and some with a group	57.1	
On my own	29.2	
When do you typically start studying for an exam? (%)		***
Daily basis	8.3	
When review sheet is available	23.21	
2 weeks before exam	14.3	
1 week before exam	44.1	
Other	10.1	
Did you watch the supplemental videos posted on the Blackboard website? (%)		***
Yes	73.2	
No	26.8	
Did the videos enhance your learning? (%)		***
Yes, most of the time	56.1	
Sometimes	41.5	
Not really	2.4	
Did you purchase, rent or borrow the course textbook? (%)		NS
Yes	50.0	
No	50.0	
How often did you read the textbook? (n= 84)		***
≤ 1 time per month – 3 times per month	79.8	
1 time per week - daily	20.2	

[z]NS,*,**, or *** is equivalent to non-significant, p= 0.05, 0.01, or 0.001, respectively using independent student t-tests for continuous variables and Chi Square analysis for categorical variables.

[y]Cumulative GPA represents the student's cumulative GPA at the start of the semester.

[x]Mean attendance: random attendance was taken a total of seven times throughout the semester.

ment (1=yes, 2=no) were the independent variables included in the regression model. The cumulative GPA used for analysis was derived from student records and represented the pre-term GPA of students at the beginning of the fall 2014 semester before completing nutritional biochemistry. P<0.05 was considered statistically significant and standardized residuals +/- 1.96 indicated a contribution to a significant relationship between groups identified in the Chi Square analysis.

Results and Discussion

This study found that students enrolled in a one-credit hour optional student-centered nutritional biochemistry recitation class had better course grades, increased attendance and better study habits compared to students enrolled in the required lecture course only (p<0.05, Table 2). These results agree with previous studies that have also observed positive academic achievement among students enrolled in recitation sections associated with "high-risk" courses, such as biochemistry, biology, accounting or economics (Etter et al., 2000; Marbach-Ad and Sokolove, 2000). The current study was unique because the recitation section was facilitated by the lecture course instructor, rather than a graduate assistant. Another distinctive feature of this study was the student-centered nature of the recitation course with the use of technology to facilitate recitation. This allowed students to set the pace of the recitation period and determined what material needed to be reviewed. Additionally, this course design required a minimal amount of preparation by the instructor, which is an important consideration when resources are limited.

A total of 173 students were enrolled in the required nutritional biochemistry lecture course. Of these, the majority were Dietetics and Human Nutrition majors, 39.9% and 56.6%, respectively with significantly fewer "other" majors, which consisted of Food Science students (p< 0.05, Table 1). The class as a whole had a cumulative GPA of 3.21 ± 0.4 and an average final course grade of 81.2% ± 11.1, with 59% of students earning an A or B in the course (p< 0.0001). Additionally, as a class, students were present for 5.91 ± 1.3 days of the 7 days when attendance was taken (Table 1).

For this project, students enrolled in recitation were required to post class-related questions to the recitation course wiki at least 15 hours prior to the recitation period. The wiki questions were then used by the instructor to initiate peer-discussion and stimulate further questions during each recitation session. Students felt this manner of content delivery was helpful or very helpful in clarifying course material (73%) and preparing for exams (72%). Additionally, 66% of students reported that they would recommend recitation to a peer.

As is typical of most supplemental recitation courses, this recitation was attached to a high-risk course, rather than to students-at-risk (Etter et al., 2000). All students

Table 2. Descriptive Statistics of Students Enrolled in Recitation/Required Lecture Course and Students Enrolled in the Required Lecture Course Only.

	Recitation and Required Lecture Course (n= 89)	Required Lecture Course Only (n= 84)	p-value [z]
Major (%)			*
Dietetics	37.5	42.5	
Human Nutrition	62.5	50.0	
Other	0	7.5	
Enrolled in Recitation (%)	51.5	48.6	NS
Cumulative GPA (SD)[y]	3.26 ± 0.40	3.17 ± 0.40	NS
Mean Final Course Grade (Grade ± SD)[x]	83.5 + 10.1	78.8 ± 11.7	*
Course Grade Distribution (%)			NS
A	27.0	20.2	
B	38.2	32.1	
C	27.0	26.2	
D	7.9	15.5	
F	0.0	6.0	
Mean Random Attendance (Days ± SD)[w]	6.2 ± 1.2	5.6 ± 1.4	**
Random Attendance Distribution (%)			*
0 – 1 days present for random attendance	1.1	2.4	
2 -3	1.1	7.1	
4 -5	18.0	29.8	
6 – 7	79.8	60.7	
Mean Exam 2 Grade from Advanced Nutrition Course (n= 140, Grade ± SD)	78.0 ± 13.5 (n=78)	74.8 ± 13.8 (n= 62)	NS
Advanced Nutrition Exam 2 Grade Distribution (%)			NS
A	26.9	17.7	
B	25.6	25.8	
C	25.6	21.0	
D	6.4	19.4	
F	15.4	16.1	
Do you study by yourself or with a group?			NS
Mostly with a group and some on my own	10.2	17.5	
Mostly on my own and some with a group	63.6	50.0	
On my own	26.1	32.5	
When do you typically start studying for an exam? (%)			*
Daily basis	14.8	1.25	*
When review sheet is available	14.8	32.5	*
2 weeks before exam	13.6	15.0	
1 week before exam	46.6	41.3	
Other	10.2	10.0	
Did you watch the supplemental videos posted on the Blackboard website? (%)			NS
Yes	73.9	72.5	
No	26.1	27.5	
Did the videos enhance your learning? (%)			NS
Yes, most of the time	53.9	58.6	
Sometimes	44.6	37.9	
Not really	1.54	3.5	
Did you purchase, rent or borrow the course textbook? (%)			
Yes	51.1	48.8	NS
No	48.9	51.3	
How often did you read the textbook? (n= 84)			NS
≤ 1 time per month – 3 times per month	80.0	79.5	
1 time per week - daily	20.0	20.5	

[z]NS,*,**, or *** is equivalent to non-significant, p= 0.05, 0.01, or 0.001, respectively using independent student t-tests for continuous variables and Chi Square analysis for categorical variables.

[y]Cumulative GPA represents the student's cumulative GPA at the start of the semester.

[x]The significant difference between final course grade between recitation and non-recitation students remained when the General Linear Regression model included "cumulative GPA" and "recitation enrollment status" as independent variables (p = *).

[w]Mean attendance: random attendance was taken a total of seven times throughout the semester.

in the course were invited to enroll on a volunteer basis. A total of 89 students (51.5%) from the required lecture course were enrolled in one of the two comparable sections of recitation. Recitation was composed entirely of human nutrition and dietetics majors, with no students from outside majors enrolled ($p < 0.05$, Table 3). No significant difference was found between the pre-term cumulative GPA among students enrolled or not enrolled in recitation (Table 2). This is an important finding because GPA is highly correlated with motivation, a key predictor of academic achievement (Cheng and Ickes, 2009). Data revealed that, among students not in recitation, 45% indicated that time conflicts with other classes or work was the most common reason for not enrolling ($p<0.0001$, Table 3). As well, 25% of students did not sign up for recitation because they felt they did not need the supplemental course ($p<0.05$). As such, students who self-enrolled in recitation were not necessarily more motivated than those that did not enroll in recitation.

Final course grade averages were higher among students enrolled in recitation, 83.5% ± 10.1, compared to those not enrolled, 78.8% ± 11.7 ($p<0.05$, Figure 1). In addition, a trend emerged of the students in recitation having more A's (27% vs 20%), and B's (38% vs 32%), fewer D's (7.9% vs 15.5%) and no F's (0% vs 6%) ($p=0.067$, Table 2). Linear regression was used to further delineate the relationship between cumulative GPA, a proxy for motivation (Romer 1993), and final course grades. The relationship of final course grades being higher among those enrolled in recitation remained significant when recitation participation and pre-term cumulative GPA were included as independent variables in the linear regression model. The regression model demonstrated that both participation in nutritional biochemistry recitation and cumulative GPA were independently associated with higher final course grades ($p< 0.05$, data not shown). The interaction term, recitation*cumulative GPA, was included in the model and was found to be insignificant thereby allowing for the interaction term to be removed from the final model. Significant positive correlations were observed between the final course grade outcome variable and the following independent variables: recitation participation ($r=0.21$), cumulative GPA ($r=0.62$), and mean random attendance ($r=0.48$) ($p<0.05$, correlation data not shown). Also, recitation participation was moderately correlated with mean random attendance ($r=0.23$, $p<0.05$).

The environment provided by recitation promoted student engagement, which has been identified as a key element to increasing student performance particularly in complex science courses (Addison et al., 2009). The wiki provided an opportunity for students to participate in the recitation in a non-intimidating manner by posting questions to the course wiki outside of class. Wikis, podcasts, blogs, clickers and other web-based tools are growing in popularity in higher education and are critical to increasing student engagement while concurrently enhancing student learning (Boulos et al., 2006). In particular, wikis are commonly used in a variety of ways to promote learning in educational settings (Boulos et al., 2006). In the current study, the instructor observed

Figure 1. The average nutritional biochemistry final course grades were significantly higher among students enrolled in recitation course versus those enrolled only in the nutritional biochemistry lecture course (*p=0.05).

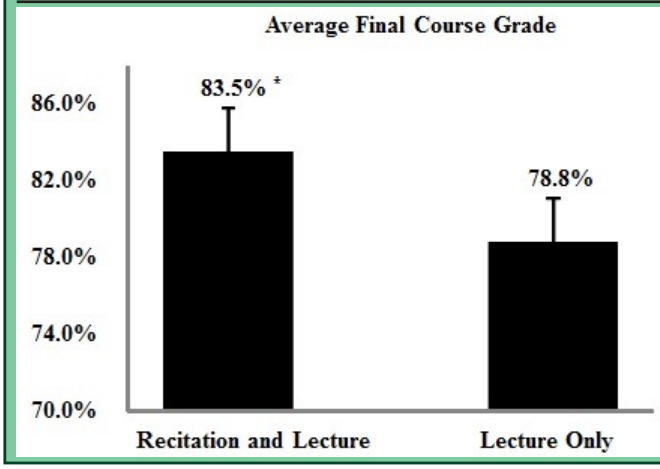


Table 3. Biochemistry Recitation Survey Results.

Survey Questions (N = 168)					p-value[z]
Would you recommend nutritional biochemistry recitation? (%)					***
Yes			65.6		
Maybe			24.4		
No			10.0		
Why did you not register for nutritional biochemistry recitation? (%) (n= 73)					*
Scheduling conflict with other classes or work			45.2		
Was not aware that recitation was offered			22.0		
Recitation was full			8.2		
Did not feel it was needed			24.7		
How helpful has recitation been to ……	**Very Helpful**	**Helpful**	**Somewhat Helpful**	**Not Helpful**	**p-value[z]**
Clarify class material?	39.8	33.0	20.5	6.8	***
Prepare for course exams?	33.0	38.6	20.5	8.0	**
Meet study partners and share resources?	20.7	18.4	32.2	28.7	NS
In general, the material presented in recitation was…..	Most of the time	Hardly Ever	Sometimes	p-value[z]	
Too basic	4.6	72.7	22.7	***	
Too complicated	11.4	42.1	46.6	***	
Too boring to listen and pay attention	15.9	43.2	40.9	*	
Too repetitive	10.2	55.7	34.1	***	
Too fast-paced	6.8	64.8	28.4	***	

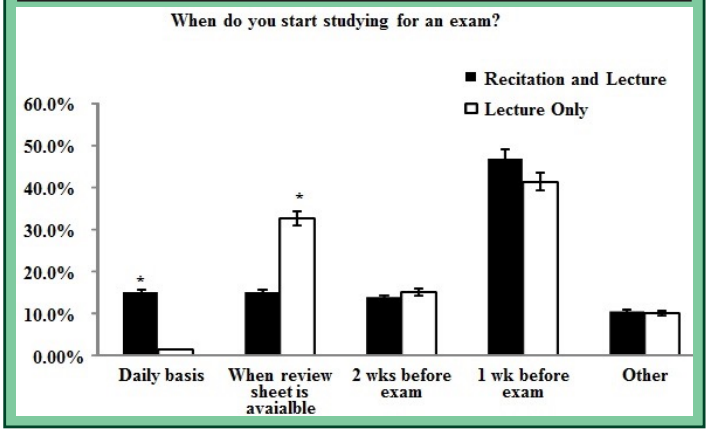
[z]NS,*, **, or *** is equivalent to non-significant, p= 0.05, 0.01, or 0.001, respectively using independent student t-tests for continuous variables and Chi Square analysis for categorical variables.

that the majority of students posted questions to the wiki because they were assigned to post on a given day; however, questions were also posted by students not required to do so for a grade. This allowed students to set the pace and determine the material that needed to be reviewed each recitation session which ensured that any confusing points perceived by students could be discussed and clarified during recitation. In addition, the use of the wiki minimized student anxiety often associated with asking questions during class (Marbach-Ad and Sokolove, 2000). As well, the wiki relieved the awkward silence instructors may encounter after asking students if they have any questions (Kanar, 2014). Another instructor-advantage of this format is that it alleviated the need to prepare worksheets or questions for each recitation session.

In the current study, recitation feedback was provided by 88 survey respondents or 99% of students enrolled in recitation. Over 70% of students found recitation to be helpful or very helpful in clarifying class material and preparing for course exams ($p<0.001$, Table 3). Students were positive about the delivery of recitation in that over 70% felt the material was hardly ever too basic ($p<0.0001$) and approximately 65% reported the pace to be appropriate most of the time. Only 16% of students felt that recitation content was consistently delivered in a "boring" manner ($p<0.05$) and even fewer, <11%, rated material as consistently being too complicated or repetitive ($p<0.0001$). Students were generally positive about recitation with 66% stating they would recommend recitation to a peer and only 10% stating they would not ($p<0.0001$, Table 3).

Previous research has shown student engagement in regular acts of studying to be associated with increased student knowledge and academic performance (Crede and Kuneel, 2008). When evaluating study habits (n= 168 survey respondents), the current study showed that over 10 times the number of recitation students were significantly more likely to study on a daily basis compared to those not enrolled, 14.8% vs. 1.25% ($p<0.05$, Figure 2). Conversely, over twice the number of students not enrolled in recitation began studying once the review sheet was available, 32.5% versus 14.8% of those enrolled in recitation ($p<0.05$, Figure 2). When considering all students enrolled in nutritional biochemistry, 44% of students began studying about one week before the exam ($p<0.0001$, Table 2). Approximately 57.1% of students reported preferring to study on their own with some study time spent with one or more people ($p<0.0001$, Table 1). However, whether a student studied alone or with a group did not impact course grades (data not shown). Among those enrolled in recitation, 39% reported that recitation was helpful or very helpful for meeting study partners (Table 3). Therefore, the added benefit of recitation facilitating study groups complimented well with the preference of the whole class to study on their own as well as with a group to prepare for exams. This style of exam preparation was not a surprising result as the instructor

Figure 2. Students enrolled in the recitation course were more likely to study on a daily basis compared to students enrolled in only the nutritional biochemistry lecture course, whereas students enrolled in the lecture course only were more likely to initiate studying once the review sheet was available (*p=0.05).



emphasized throughout the semester that studying with others could enhance their comprehension of nutritional biochemistry.

Attendance, as assessed by random attendance taken seven different days during the semester, was significantly higher among recitation students, 6.2 ± 1.2 vs. 5.6 ± 1.4 days ($p<0.001$). The data revealed that attendance was significantly and strongly correlated with the final course grade, $r=0.48$ ($p<0.05$, data not shown). This demonstrates that attendance itself was a critical factor in student success. Interestingly, there was a moderate correlation between recitation participation and increased attendance ($r=0.23$, $p<0.05$), correlation data not shown). Therefore, it is not unreasonable to suggest that participation in recitation contributed to success by increasing the likelihood of students attending class more regularly thereby increasing their exposure to course material beyond that of students not enrolled in recitation. As noted by Romer (1993), the effect of attendance on student performance is difficult to isolate and assess, but increased class attendance does appear to be significantly associated with course grades.

The effect of class size on student achievement in higher education is still a matter of debate (Kokkelenberg et al., 2008), but several studies have demonstrated that smaller sized classes create an environment geared towards critical thinking and advanced problem-solving (McKeachie et al., 1990). The recitation classes were one-quarter the size of the regular lecture course and allowed for the sessions to be directed towards critical thinking and problem-solving on a regular basis. This may have contributed to the success of recitation because the students enrolled in lecture only did not have the opportunity to do this as frequently.

The student-centered learning style offered by the biochemistry recitation class has been shown to increase retention of course knowledge (Collins and O'Brian, 2003). To assess retention, the current study compared the grades of an exam given in an advanced nutrition course that was offered the spring semester following

the fall nutritional biochemistry course and taken by 80% of the students. The exam in the advanced nutrition course tested the important concepts of macronutrient metabolism that was covered in detail throughout the biochemistry course. The results demonstrated that the average score on the advanced nutrition exam was trending towards being higher among students that were enrolled in recitation the previous semester, 78.0 ± 13.5 vs. 74.8 ± 13.8 (Table 2). Furthermore, students enrolled in recitation had more A's and fewer D's on the advanced nutrition exam (p= NS, Table 2). A significant finding may have emerged if 100%, rather than 80%, of the students that took the fall biochemistry course would have taken advanced nutrition the subsequent semester. While a required course for dietetics and human nutrition students, the course is not required for food science students (3.5% of original biochemistry course roster) and some students chose to take the advanced nutrition course at a later time. This data suggests that there may be a relationship between enrollment in recitation and subsequent achievement in a follow-up course, but further research is needed.

There were no differences between groups regarding the tools used to supplement their learning and studying. Both groups were similar in their use of the instructor-posted videos that were available on the nutritional biochemistry course online learning platform. Additionally, both groups infrequently used the textbook (Table 2). An interesting finding pertaining to all of the students enrolled in the nutritional biochemistry lecture course was that the vast majority of students preferred to supplement their learning of macronutrient metabolism with instructor-posted videos rather than the optional course textbook.

Limitations

Overall, this study found that students enrolled in a supplementary nutritional biochemistry recitation course that used a student-focused approach had significantly increased final course grades beyond students enrolled in the lecture course only. The study, however, did have several limitations. For one, students were not randomly assigned to enroll in recitation which could introduce a sample bias whereby more motivated students took the recitation course and, therefore, would be more successful in the course regardless of the recitation. Despite such potential, this research showed no significant difference in cumulative GPA, a proxy for motivation, between the groups. As well, when GPA was included in the regression model, biochemistry recitation remained independently associated with increased course grades.

Due to limited resources an alternative control recitation section was not offered. Despite not offering a control recitation, the positive results of the current study suggests that delivering recitation in this student-driven manner works as well as traditional recitation courses. A limitation pertaining to the requirement of posting a question to the wiki is that students may have posted a question because it was an assignment, rather than because they truly needed a question answered. While a limitation to the research, from an instructional standpoint, posting of any questions provided an opportunity to initiate classroom discussion and foster student learning. As far as the significant findings of increased studying and attendance among recitation students, it was beyond the scope of the study to assess the quality of the time spent studying or to delve into why students did not attend class. Previous research demonstrates the positive effects that study time and class attendance have on student achievement. Therefore, it is not unreasonable to associate these characteristics with student achievement (Crede and Kuneel, 2008). The current study did not assess the validity or reliability of the exams and assumed the exams included information that students had been taught.

Summary

In conclusion, students enrolled in a student-driven nutritional biochemistry recitation course had significantly higher final course grades and better attendance and study habits compared to those not enrolled in recitation. Supplementing student learning of nutritional biochemistry with an effective recitation course is critical for student success because nutritional biochemistry contains the foundational knowledge critical to the health, animal and food science fields of study.

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Research Internships: A Useful Experience for Honing Soft and Disciplinary Skills of Agricultural Majors[1]

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Abstract

Agriculture graduates must be able to integrate knowledge and skills from different disciplines and use them along with their soft skills to function effectively. Interdisciplinary areas such as sustainable agriculture can enable students to acquire experiential learning through research internships while fulfilling this career requirement. Thus, 22 agriculture students at two land grant universities, engaged in agriculture-oriented research to improve their skills for their careers. The overall goal of this project was to develop and use evaluation instruments to assess the perceptions of undergraduates' skills through research internships. Each student worked for two consecutive semesters on a research topic, such as organic farming, small-scale agriculture, or water quality. Based on assessments during the internship and exit surveys, interns and their mentors perceived that students improved in most of the targeted skills, including written and oral communication. Their critical thinking was also improved according to the student's exit survey and the mentors' evaluation. Writing was perceived as the lowest among students' skills, even after improvement students showed 59% proficient. This study showed that agriculture majors benefited from the research internships and therefore, these programs should be continued in order to prepare more agriculture students to compete in the workforce.

Introduction

As today's labor market becomes more competitive, jobseekers need to continually broaden their soft skills, even as they improve their disciplinary or hard skills (Association of American Colleges and Universities and Hart Research Associates, 2013; Bancio and Zevalkink, 2007; Crawford et al., 2011). For agricultural graduates, this will require the integration and effective use of their knowledge and skills, which they gained from different disciplines, as well as, the appropriate use of interpersonal/behavioral/workforce/soft skills. These latter competencies; hereafter, referred to as soft skills are grouped into seven clusters according to Crawford et al. (2011), namely; communication, decision making /problem solving, self-management, teamwork, professionalism, leadership and experiences. However, some of them are rated more highly than others (National Research Council, 2009) and a recent survey by Association of American Colleges and Universities and Hart Research Associates, (2013) found that over 75 % of employers wanted more emphasis in five key areas including critical thinking, complex problem-solving, written and oral communication and applied knowledge in real-world settings. Contrary to expectations, some of these skills; including critical thinking, problem-solving and communication, are noted by employers as deficient in some graduates (APLU, 2009; National Research Council; 2009, Rudd et al., 2000; Schmidt, 1999; Telg and Irani, 2005). These competencies require higher levels of cognition based on Blooms taxonomy of cognitive skills, (Bloom, 1956), as students struggle to master them in their writings based on experiential activities (Marsh, 2000) and in their scores from critical thinking ability constructs (Torres and Cano, 1995).

Effective demonstration of critical thinking can be done through the student's ability to convey their competency in writing or in speaking. However, there are many views of critical thinking (Rudd, 2007), including those of Pascarella and Terezini (1991) that it involves an individual's ability to *"identify central issues and assumptions in an argument, recognize important relationships, make*

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correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority" (p.118). By adapting these tenets of critical thinking to applicable experiential learning activities for students, both critical thinking and communication skills can potentially be improved.

The use and theory of experiential learning has been studied for nearly a century (Dewey, 1938; Knobloch, 2003; Kolb, 1984; Retallick and Steiner, 2009; Roberts, 2006). According to Knobloch (2003), experiential learning has four tenets: learning through real life context, learning by doing, learning through projects and learning through problem solving. This type of learning can also be characterized as a cyclic process or by the context in which it occurs (Roberts, 2006). Experiential learning methods focus on critical linkages between the classroom and the real world (Kolb, 1984). Recent reports demonstrate the effectiveness of experiential learning in undergraduate education in food and agriculture science areas (Powell et al., 2009; Retallick and Steiner, 2009; Good et al., 2013; Odera et al., 2015). Undergraduates in science disciplines can engage in these experiences throughout the year, but many are offered as intensive short term summer programs (Good et al., 2013; Odera et al., 2015; Haen et al., 2012). Moreover, undergraduate research experience may also enhance some skills better than others (Kardash, 2000). Therefore, the objectives of this study were to: (1) to develop and use a survey to assess students' and mentors' perceptions of students' soft skills at the beginning and later stages of their research internship experiences, (2) to develop and use a rubric to measure the critical thinking and communication skills of undergraduate students engaged in research internships in sustainable agriculture and (3) to develop and use a survey to assess students' perceptions of their research internship experience following the completion of the experience.

Materials and Methods

Objective: To develop and use a survey to assess students' and mentors' perceptions of students' soft skills at the beginning and later stages of their research internship experiences:

Between spring 2011 and summer 2015, twenty-two agriculture majors from two land grant universities participated in sustainable agriculture research experiences to enhance their skills. Most (90%) of these students were juniors and sophomores, but a few freshmen were also accepted to the program following the submission of a two-page essay on why they were interested in the internship. There were 13 males (59%) and nine females (41%); comprised of two ethnicities, Caucasian (41%) and African American (59%). Each student received a laboratory book and was paired with a research mentor who helped him/her develop disciplinary and soft skills, while gaining the research experience. To gauge students' opinions about their skills, the mentors developed a survey comprised of 13 skills categories; punctuality, willingness to learn and accept change, dependability, initiative, responsibility, professionalism, writing, oral communication, critical thinking/problem solving, knowledge of project, progress on project, interest in project and ability to work with others. Each skill was evaluated on a four-point, Likert–type scale where 1 = poor, 2 = average, 3 = good, and 4 = excellent. Within the first month of the internship and progressively throughout the experience, each student completed a self-assessment using the instrument. After reviewing this assessment, the mentor discussed it with the intern, provided his/her own assessment and gave feedback on areas of strengths and weaknesses. Mentors based their assessments on observations of student attitudes, write-ups on proposed projects, project implementation including lab book details, project completion and presentations at meetings including professional conferences. A research rubric (Table 1) on the critical thinking and communica-

Table 1. Rubric Used in Evaluating Undergraduate Research Interns on Critical Thinking and Communication Skills and Showing Percent of Interns by Proficiency According to Mentors

Criterion/Outcomes	Levels of Proficiency and Percentage[Z]		
	Not proficient	Marginally proficient	Proficient
1. Identify research problem	Make observations about research problem (45.5→0)	Make observations and inferences about research problem (50→4.5)	Make observations and inferences about research problem, and clearly identify research issue (4.5→ 95.5)
2. Write clear and concise hypotheses	Identify the hypothetical factors/situations (63.6→0)	Identify the hypothetical factor/s, perceive relationships and draft the project statement (36.4→22.7)	Identify the hypothetical factor/s, make relationships and formulate a clear statement (0→77.3)
3. Conduct literature review	Describe relevant background information (59.1→0)	Describe and analyze relevant background information (40.9→36.4)	Describe, analyze and integrate relevant information (0→63.6)
4. Identify steps to solve problem and set up experiment	Describe plan of experiment (81.9→0)	Describe and design plan of experiment (18.2→ 13.6)	Describe, design and use experiment plan to accurately lay out study (0→ 86.4)
5. Collect and manage data	Collect research data (72.7→ 0)	Collect and arrange data for analysis (27.3→ 36.4)	Collect, arrange, analyze and use data (0→ 63.6)
6. Prepare written research document	Write clear documents that describes research findings (86.4→ 4.5)	Write clear document that describes and analyzes research findings (13.6→36.4)	Write clear document that describes, analyses and integrates research findings and formulates logical conclusions and applications (0→ 59.1)
7. Make oral presentation on research data	Present clear oral presentation/s describing research findings (77.3→4.5)	Present clear oral presentation/s that describe and analyze research findings (22.7→13.6)	Present clear oral presentation that describes, analyses and integrates research findings, and formulates logical conclusions and applications (0→ 81.9)

[Z] Number in each proficiency level followed by arrow represents mentors' assessment of % students in criterion at the beginning and end of the internship.

tion skills was another resource used by mentors in their evaluation of these two categories. Students worked as paid research interns for 20-hours/week for two semesters on various research topics, e.g., organic farming, small-scale agriculture and water quality/nutrient management.

Objective: To develop and use a rubric to measure the critical thinking and communication skills of undergraduate students engaged in research internships in sustainable agriculture:

A rubric (Table 1) was developed by the mentors to assess the student learning outcomes for advanced levels of critical thinking in planning, conducting, and communicating research findings. It included modified aspects of a research instrument of Kardash (2000) that included 14 research skills. The rubric contained selected criteria to measure critical thinking and communication skills at three proficiency levels. A three-point, Likert-type scale was used to measure these levels where 1, 2 and 3 were not proficient, marginally proficient and proficient, respectively. Embedded in each proficiency level for each criterion were expected critical thinking levels for observing, making inferences, recognizing relationships, analyzing, deducing conclusions or application phases. The seven selected criteria were based on the scientific method and included: identification of the research problem, writing hypotheses, conducting literature reviews, setting up experiments, collecting, analyzing and managing data, developing a written research document and making oral presentations on research data and results. The rubric was given to each mentor and used as a guide in the development and implementation of the research experience. Pre-and post-data were collected by mentors on each student within the first and final month of the internship, respectively.

Objective: To develop and use a survey to assess students' perceptions of their research internship experience following the completion of the experience:

At the end of the internship, students completed an exit survey to provide feedback on their experiences. The survey was developed by mentors and comprised of 14 statements, including an open ended one for their comments. It included their opinions on their development of communication, critical thinking and research skills, and the process of the internship. Each statement was evaluated on a scale where 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; and 5 = strongly agree.

Data analyses and institutional review:

Data were analyzed using SAS (2008). Paired t-tests were analyzed on pre- and post-assessment to determine overall perceptions for student and mentors. All surveys were deemed exempt by the institutional review board of the university.

Results and Discussion

Students' and Mentors' Perceptions of Students' Soft Skills

This experience enabled undergraduate interns to choose their research topics and receive guidance from faculty mentors as the ideas were crystallized and the projects implemented. It empowered them to develop their creativity and hone their skills. These results are also in congruence with the agriculture workforce skills attained by students in other initiatives such as the individualized graduate and undergraduate learning contracts of Miller-Foster et al., 2015 and the summer internships of Good et al., 2013; Odera et al., 2015 Haen et al., 2012. In this study, the interns perceived themselves as improved in eight of the 13 skills' categories in which they were assessed (Table 2). These were: responsibility, professionalism, writing, oral communication, knowledge of project, progress on project, interest in project and interpersonal relationships. In general, they believed that they were good in the other categories; punctuality, willingness to learn and accept change, dependability, initiative and critical thinking.

Similar student self-perceptions of improved communication, critical thinking and research ability were reported by others (Good et al., 2013; Odera et al., 2015, Haen et al., 2012). The results of the assessments by the mentors indicated that our interns significantly ($P<0.05$) improved in all skills, except willingness to learn and accept change (Table 3). Students and mentors scored writing skills lowest among all the skills at the end of the internship with 2.96± 0.89 and 2.93± 0.68, respectively (Tables 2 and 3). While these skills were improved significantly from average to good in the two semester experience, there was still room for further improvement beyond the life of the internship.

Table 2. Results of Paired Student's t-test Comparing Pre and Post Internship Student Perceptions of their Skills

Criterion	Student Pre Internship		Student Post internship		t-value	[Y]Signif. (2-tailed)
	[Z]Mean	SD	Mean	SD		
Punctuality	2.95	0.69	3.06	0.83	-0.49	NS
Willingness to learn and accept change	3.40	0.68	3.51	0.61	-1.00	NS
Dependability	3.15	0.59	3.41	0.50	-1.56	NS
Initiative	2.95	1.00	3.16	0.81	-1.29	NS
Responsibility	3.10	0.72	3.51	0.61	-2.37	*
Professionalism	2.75	0.859	3.21	0.70	-2.44	*
Writing Skills	2.45	0.89	2.96	0.89	-3.25	**
Oral Communication Skills	2.95	0.83	3.26	0.79	-1.67	**
Critical thinking problem solving	2.90	0.85	3.11	0.64	-1.97	NS
Knowledge of project	2.30	1.03	3.26	0.64	-4.05	***
Progress on project	2.30	0.92	3.11	0.55	-3.39	**
Interest in project	3.20	0.83	3.65	0.49	-2.13	*
Interpersonal	3.08	0.76	3.65	0.47	-2.71	**

[Z] Scale: 1=poor, 2= average, 3= good, 4 = excellent.

[Y] NS, *, **, ***, Non-significant, or significant at P=0.05, 0.01, or 0.001, respectively based on paired t-test.

This observation was communicated to students in one-on- one discussions during the internship. Generally, the mentors also rated the students lower than their self-assessed score. (Tables 2 and 3).

Rubric to Measure Critical Thinking and Communication Skills of Undergraduates in Research Internships

The research process using the designed rubric allowed each student to understand and address a research problem. Similar benefits of research to undergraduates have been reported by others (Kardash, 2000; Lopotto, 2004; Odera et al., 2015; Haen et al., 2012). Student interns made good progress in the outcomes/criteria for critical thinking and communication with at least 55% of them advancing to each of the proficient categories (Table 1) and demonstrating tenets of critical thinking as described by Pascarella and Terezini (1991). Fewer than 5% were in the not proficient category at the end of the internship. They achieved highest proficiency level (95%) in making correct inferences. However, writing a research document was the most challenging outcome with 59.1% earning proficiency. For writing as well as some of the other outcomes, the ability to analyze, integrate, apply and make recommendations was necessary. While students were able to effectively perform analysis in the marginally proficient category, the integration, application and recommendations were the challenges that ranked in the proficient category. The lower scorings of students' writing by mentors using the rubric were also in agreement with that of the students themselves in scoring writing lowest in their self-assessment (Table 2).

Overall, the pre-and post-assessment of the interns by the mentors showed significant growth of the student interns for all research criteria assessed from not proficient towards proficient (Table 4). Although we did not conduct student self-assessments with this rubric, their improvements in carrying out the scientific concepts, as scored by the mentors, reflected similar trends to those of other self-assessed, undergraduate research interns (Haen et al., 2012). Both data from the rubric and soft skills instrument were valuable to students in providing formative feedback that allowed them to reflect and work on improving these skills during the research experience.

Exit survey to assess students' perceptions of their research internships

Students' responses to all program evaluation statements related to the internship program were positive (Table 5). They unanimously agreed that working with their mentors helped them develop their skills. Similar

Table 3. Results of Paired Student's t-test Comparing Pre and Post Internship Mentor Perceptions of Students Skills

Criterion	Student Pre Internship		Student Post internship		t-value	[Y]Signif. (2-tailed)
	[Z] Mean	SD	Mean	SD		
Punctuality	2.77	0.62	3.36	0.73	-3.05	**
Willingness to learn and accept change	3.43	0.49	3.66	0.47	-1.74	NS
Dependability	2.91	0.61	3.45	0.59	-3.46	**
Initiative	2.86	0.71	3.41	0.50	-3.46	**
Responsibility	3.09	0.43	3.59	0.50	-3.92	**
Professionalism	3.05	0.650	3.36	0.73	-2.63	*
Writing Skills	2.14	0.68	2.93	0.68	-6.80	***
Oral Communication Skills	2.91	0.75	3.50	0.67	-5.51	***
Critical thinking problem solving	2.48	0.66	3.09	0.63	-5.00	***
Knowledge of project	2.05	0.84	3.36	0.58	-6.54	***
Progress on project	2.25	0.67	3.55	0.51	-10.65	***
Interest in project	3.20	0.77	3.70	0.50	-2.92	**
Interpersonal	3.03	0.55	3.47	0.72	-4.18	***

[Z] Scale: 1=poor, 2= average, 3= good, 4 = excellent. n=22.

[Y] NS, *, **, ***, Non-significant, or significant at P=0.05, 0.01, or 0.001, respectively based on paired t-test.

Table 4. Pre and Post Assessment by Mentors of Interns Using a Rubric to Evaluate Undergraduate Research Interns on Critical Thinking and Communication Skills in Research

Criterion/Outcomes	Pre Internship		Post Internship		t-value	[Y]Signif. (2-tailed)
	[Z]Mean	SD	Mean	SD		
1.Identify research problem	1.59	0.59	2.95	0.21	-11.01	***
2. Write clear and concise hypotheses	1.34	0.47	2.78	0.43	-11.51	***
3. Conduct literature reviews	1.41	0.50	2.64	0.49	-8.40	***
4. Identify steps to solve problem and set up experiment	1.18	0.39	2.86	0.35	-16.55	***
5. Collect and manage data	1.27	0.46	2.64	0.49	-12.99	***
6. Prepare written research document	1.14	0.35	2.55	0.59	-11.20	***
7. Make oral presentation on research data	1.23	0.43	2.77	0.53	-10.80	***

[Z] Scale: 1=not proficient, 2= marginally proficient, 3= proficient. n=22

[Y] NS, *, **, ***, Non-significant, or significant at P=0.05, 0.01, or 0.001, respectively based on paired t-test.

Table 5. Percentage of Agriculture Undergraduate Interns (n=22) Survey Respondents Indicating the Level of Agreement with Statements Related to Research Internships

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Those scoring >Agree
Working with my mentor helped me to develop my skills	0	0	0	4.5	95.5	100
I increased my critical thinking skills	0	0	4.5	36.4	59.1	95.5
The opportunities for presenting at professional meeting helped me to grow	0	0	4.5	27.3	68.2	95.5
I developed my research skills	0	0	4.5	27.2	68.2	95.4
The experiential activities increased my understanding of research issues	0	0	4.5	18.2	63.6	95.4
The self and mentor evaluation of my workforce skills helped me develop	0	0	9.1	45.5	45.5	91.0
I Gained knowledge in sustainable agriculture	0	0	9.1	22.7	68.2	90.9
I increased my communication skills	0	0	9.1	31.8	59.1	90.9
I feel better prepared for graduate school	0	0	13.6	22.7	63.6	86.3
I feel better prepared for the workforce	0	0	27.3	36.4	36.4	72.8
The rubric was useful in assessing my critical thinking and communication skills	0	0	4.5	31.8	40.9	72.7
If there were no paid internships, I would participate in this internship	0	9.1	18.2	40.9	31.8	72.7
Two semesters were adequate for my research internship	0	18.2	27.3	40.9	13.6	54.6

positive student perceptions of research mentorships have also been reported, even in shorter duration programs such as summer internships (Glenn et al., 2013). Our students also agreed that the experiential activities increased their understanding of research issues. They felt that they were better prepared for graduate school and the workforce and that the opportunities for presenting orally and in poster format at professional meetings helped them to grow professionally. In agreement with the previous assessments from the rubric scores (Tables 1 and 4) by the mentors, they also felt that their communication and critical thinking skills (Table 5) were vastly improved.

The overall response of over 70 % intern agreement on the survey statements were very positive, except for the one about the duration of the internship. Only 54.6% believed that two semesters were adequate for the program. The neutral feelings (27.3%) or disagreement (18.2%) of this group (45 %) on the duration raises the question of whether a longer period would have enabled more improvement in some for the skills such as writing. This is an item that probably should be taken into consideration in planning future internships, whether paid or unpaid, since most (72.7%) agreed that they would have participated even if they were not paid.

From the open-ended comments from the exit survey, common student perceptions were that the techniques and workforce preparedness skills obtained would help them find other internships and jobs and that their communication skills and self-confidence were vastly improved. These perceptions are in concurrence with reports that students with internship experience are more likely to get hired after college than peers lacking internship experience (National Association of Colleges and Employers (NACE) 2014; US News, 2010). According to the NACE report, in year 2014, 52% of those graduates receiving job offers before graduation had held internships. This trend is likely to continue, leaving open the need for internships like this research one.

Conclusions

Based on the information gained from the three assessments instruments used in this research internship program and the 22 student interns who participated, indications are that the program was a success and was beneficial in improving students' skills for workforce and other professional endeavors. This is substantiated by the feedback from interns, most of whom agreed that their skills were improved in oral and written communication, critical thinking, research techniques, identification of real-world and pertinent research issues, workforce and graduate school preparedness, professionalism and interpersonal and responsibility/dependability. While the sample size was not large, the rubric and some of the data obtained by using the rubric employed in this study may be applicable for use in future student intern programs.

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Scholar Development: A Conceptual Guide for Outreach and Teaching[1]

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Abstract

External funding opportunities are often associated with "broader impact" activities aimed at improving public scientific literacy and helping to build the future scientific workforce. Increased outreach by agricultural science professionals has the potential to assist the public in building the competencies needed to pursue a range of careers in agricultural sciences. However, engaging in high quality science outreach often requires faculty scholars to cross complex social and institutional boundaries. This paper presents concepts that are critical for helping graduate students better understand and enact effective and efficient science outreach and teaching. Science outreach and teaching best practices include: a) professional development focusing on strategic planning, time management, relationship building and the appreciation of alternative viewpoints; b) the employment of teaching and learning resource professionals to assist in the development of competencies; and c) the expansion of opportunities to build outreach activities into graduate student training, assisting in expanding a culture of scientific outreach.

Introduction

Graduate education draws heavily on an apprenticeship model of adult learning which views the graduate student experience as a process of professional socialization into academia (Buck et al., 2006; Christodoulou et al., 2009; Collins, 2011; Crone et al., 2011). Preparation for entry into scholarly professional communities is facilitated through authentic experience with all aspects of future work, including outreach, teaching and research for developing university faculty (Austin, 2002). Within the process of socialization into academia it is likely that different programs of study will place varying degrees of emphasis on the outreach and teaching aspects of the authentic experience process (Blickenstaff et al., 2015). While it is likely that the competencies associated with outreach and teaching will be valued by faculty guiding the scholarly development of graduate students, it is commonly the case that those aspects receive less attention and are outside of the guiding faculty's primary skillset (Smith et al., 2014). Currently, there is a dearth of literature that describes or assesses the design or implementation of an outreach program geared towards assisting graduate students to develop outreach and teaching competencies through an experiential learning process. It will be useful, therefore, to offer a conceptual description of how an outreach program could be utilized to build the outreach and teaching knowledge and skills of graduate students through just-in-time instruction and authentic outreach experience.

Just as the public has become increasingly more disconnected from agriculture, its connection to science seems to be thinning as well. It is critical that budding faculty scholars build outreach and teaching competencies so that they can effectively and efficiently share new knowledge in ways that are conducive for building the public's understanding and support for science (Blickenstaff et al., 2015). In fact, as Wellnitz et al. (2002) point out, programs of study should help graduate students recognize that part of their professional practice will include communicating to people outside of the science and academic enterprise system their understandings, discoveries and new directions for inquiry. As an extension, it then follows that, graduate students should be engaged in outreach and teaching experiences with the hope of instilling within them competencies such as effective cooperation, communication and pedagogical expertise early in their budding careers (Bruce et al., 1997; Burrows et al., 2009; Collins, 2011; Crone et al., 2011; Montano, 2012; Nilsen, 2013).

However, one of the central challenges for science based graduate programs of study is authoring and enacting experiential opportunities which guide graduate students through a process of constructing understandings and meanings around high quality outreach and teaching. Further, if authentic guided experience doing science serves to build the research and scientific problem solving capacity of graduate students, then

[1]This study was deemed exempt from IRB review because it is a conceptual paper and did not require collection of data from participants.

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authentic experiences with communicating and teaching about science are critical for developing their thinking about and ability to enact high quality outreach and teaching. When working to engage graduate students in a process of developing their outreach and teaching abilities, there is merit in working with faculty and resource persons with expertise in those areas (Smith et al., 2014; Stedman and Adams, 2012). Faculty with expertise in teaching and learning can be engaged in order to help graduate programs of study design and enact efficient pathways that can guide graduate students through an experiential process of developing their outreach and teaching abilities. It is the expert guidance from knowledgeable teaching and learning faculty and resource persons and the time to engage in actual practice, just as in learning about the process of science, that can help graduate students construct a deeper understanding of goal setting, instructional planning, and assessment through ongoing expert feedback and self-reflection (Fenwick, 2003; Kolb, 1984).

The purpose of this paper is to tie together the related research and theoretical perspectives in order to describe a conceptual level guide for using K-12 outreach teaching experiences to build the capacity of graduate students to: a) connect research with value adding diffusion strategies that contribute to the public's understanding of science; and b) employ research based instructional strategies to construct and enact high quality science based learning experiences. The guiding conceptual framework is constructed by tying together constructivist, situated learning and activity theory perspectives in concert with research related to the need for agricultural and scientific literacy and the challenges associated with building outreach and teaching competencies. The value in illustrating a conceptual level guide is that it will easily transpose to a wide variety of contexts which may have different parameters, resources and limitations.

Constructivist Perspective

Fenwick (2003) notes that all instructional strategies, including experiential methods, can be viewed from multiple theoretical perspectives. In the constructivist perspective, learning is grounded in experience, sociocultural beliefs and prior knowledge (Black, 2003; Klassen, 2006). Knowledge is acquired through constant reflection on new experiences within the context of what was already known by the learner and how it was known. Within the constructivist perspective learning is "contextualized" because of how novel experiences dovetail with previous understandings about the world which resulted from the physical and social experience of daily life (Fenwick, 2003; Klassen, 2006).

The idea of experiential education is frequently attributed to the early 20th century educational philosopher John Dewey, who popularized learning through real-life contexts in his Laboratory School (Clark et al., 2010; Enfield, 2001; Fenwick, 2003; Knobloch, 2003; Kolb, 1984; Phipps et al., 2008; G. Smith and Sobel, 2010). The constructivist conception of experiential learning is based on the Dewey's work, along with other major theorists Vygotsky, Lewin and Piaget (Fenwick, 2003). These constructivists considered concrete experience to be the fundamental basis for learning in a continuous process of reflection, assimilation and further observation to connect conflicting concrete and abstract conceptualizations of the world (Fenwick, 2003; Kolb, 1984).

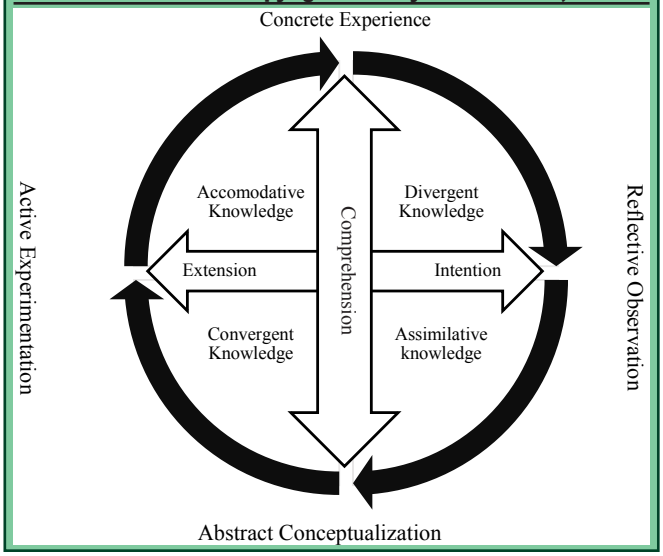
Clark et al. (2010) note that experiential learning can occur via application of knowledge in immediately relevant settings or through connection of daily life experience to abstract concepts. Regardless of the mode, the process is grounded in real-life experience and consists of a holistic combination of action, perception, cognition and reflection (Fenwick, 2003; Kolb, 1984). The extent to which a learner is prepared for an experience will influence his or her ability to interpret and connect new learning to prior knowledge as well as to transfer or apply it in new contexts (Abdulwahed and Nagy, 2009; Fenwick, 2003). Before, during and after an experience, learners are encouraged to reflect on the content, process and premises - asking what happened, how and why – and to consider their underlying assumptions about the phenomenon (Baker et al., 2014; Clark et al., 2010; Fenwick, 2003).

Dewey referred to the principle of "interaction and continuity" to describe the idea that the learning process is inherently social, builds upon prior experience and should provide a platform upon which to build through successive, structured experience connected to content (Dewey, 1986; Enfield, 2001). The iterative nature of learning is emphasized throughout the constructivist approach, but was particularly popularized by Kolb in his 1984 work, The Process of Experiential Learning (Abdulwahed and Nagy, 2009; Baker et al., 2012; Clark et al., 2010; Knobloch, 2003; Kolb, 1984; Mowen and Harder, 2005).

Figure 1 illustrates that Kolb's experiential learning cycle consists of continuous movement through phases of concrete experience, reflective observation, abstract conceptualization and active experimentation (Abdulwahed and Nagy, 2009; Clark et al., 2010; Kolb, 1984). Learning can begin at any stage and consists of the combination of apprehension and comprehension, by which knowledge is grasped, along with intention and extension, through which knowledge is constructed (Abdulwahed and Nagy, 2009; Clark et al., 2010). Acquisition of knowledge most commonly occurs through concrete experience or abstract conceptualization and is also referred to as prehension. In Kolb's view, reflection and experimentation result in knowledge construction or "transformation" (Abdulwahed and Nagy, 2009).

Constructivist experiential learning theory strongly informs the pedagogical standpoint of most science outreach education efforts (Bruce et al., 1997; Burrows et al., 2009; Collins, 2011). It also strongly informs the philosophies of 4-H and K-12 Agricultural Education, which espouse "learning by doing" and "hands-on" learning in their respective programs (Carmichael et

Figure 1: Structural Dimensions Underlying the Process of Experiential Learning and the Resulting Basic Knowledge Areas. Adapted from Experience as the Source of Learning and Development (p. 42) by D.A. Kolb, 1984, Englewood Cliffs, NJ: Prentice Hall. Copyright 1984 by Prentice Hall, Inc.



al., 2010; Clark et al., 2010; Mowen and Harder, 2005; Phipps et al., 2008). Many STEM outreach programs, including 4-H, incorporate inquiry-based or problem-based approaches to learning science content – a modification of the experiential approach. Common to all of these approaches is the back-and-forth flow between experience/exploration and reflection/conceptualization, resulting in application (Clark et al., 2010). In a program designed to build outreach and teaching capacity through "learning by experience," there should therefore be a strong focus on helping developing scholars to incorporate constructivist experiential approaches into their outreach curriculum activities (Dolan, 2008). Therefore, the constructivist perspective on experiential learning should not only be used as a model to describe the developing scholars' experiences – it also has the potential to influence their conceptions of themselves as outreach and teaching professionals.

Situated Perspective

Situated learning offers an additional theoretical perspective that has value within the context of graduate student training. From a situated learning perspective, one could view graduate students as peripheral scholarly participants who are being socialized into an academic community of practice (Austin, 2002; Collins, 2011). Situated learning draws on the social constructivist school of thought, however, one of Lave and Wenger's critiques of the constructivist perspective is an over-emphasis on the individual, internalized view of learning (Engeström et al., 1999; Lave and Wenger, 1991). Informed by activity theory, situated learning extends the perspective on learning to include the ways in which the learner's "social world" affects learning. This includes the ways in which the learner might influence that world, as exemplified in the interaction between newcomers and established members in a community of practice (Lave and Wenger, 1991; Wenger, 1998).

Situated learning is most commonly applied to the apprenticeship perspective on adult learning, according to Pratt (1998). A fundamental assumption which arises from the situated learning framework is that outreach and teaching work cannot be learned outside of the context of practicing it (Pratt, 1998). Some fundamental aspects of apprenticeship include increasing participation in the ongoing work of the community, a direct relevance of the learning setting to future work and the predominance of practically focused, performance-related goals (Lave and Wenger, 1991). The ultimate goal of situated learning is for learners to achieve full participation in the community of practice in which they are apprenticing. A community of practice is defined as a group of people connected by mutual engagement in an activity. This is their only common feature – it does not, therefore, imply homogeneity or harmony in any way other than that of the standards of practice dictated by the field (Wenger, 1998).

Activity Theory Perspective

The constructivist and situated perspectives describe the ways in which the graduate student scholars might incorporate pedagogical expertise and philosophical perspectives into their identities and practice. Activity theory views learning from the perspective of interacting cultures, groups, or "activity systems," and therefore offers an additional perspective on learning experiences. Engeström (2001) conceptualizes a "third generation activity theory" in which two interacting systems – referring to individuals or groups - are the unit of analysis. These systems work together to co-create a new meaning, product, or process referred to as the "object of study". Interacting individuals or groups carry with them influences of their "home" community - its organizational history, knowledge base, norms, rules, division of labor, etc. These underlying influences cause "contradictions" (aka boundaries) between and within activity systems. Third generation activity introduces the possibility of "expansive transformation" by which the two systems transcend their contradictions and move toward collective change or collaborative vision (Daniels, 2004; Engeström, 2001; McMillan, 2011).

From the perspective of activity theory, "boundary spanning" refers to the process by which individuals enter unfamiliar territory beyond their qualifications to accomplish "expansive transformation" (Akkerman and Bakker, 2011). Boundary spanning is the driving mechanism for inter-organizational collaboration. Star and Griesemer (1989) refer to it as the flow of objects and concepts through the collaborative network. Boundary-spanning interaction is two-sided and embraces differences of all types, to include those of culture, discipline, knowledge, or language (Akkerman and Bakker, 2011; Lamont and Molnár, 2002; Long et al., 2013). It also requires "crafting, diplomacy and choice" (Star, 1989, p. 389) to manage processes across social worlds (p.389). McMillan (2011) summarizes boundary spanning as forming an "expanded community" which

reaches beyond the home institution to engage in new ways that challenge the existing activity system.

The development of new partnership projects such as a program for developing the outreach and teaching capacity of graduate students inevitably necessitates boundary spanning. In Wenger's (1998) conception of this process, three things mediate the interaction. Encounters, meetings and conversations across communities of practice likely emerge first. These are followed by the development of objects or tools used to negotiate across these communities and facilitate interaction. Boundary "brokers" (or workers) serve as "key agents" of facilitation, usually legitimized by their multi-membership in the collaborating communities (McMillan, 2011; Wenger, 1998). The job of a boundary-worker is to bring people together, identify shared goals, support transfer of knowledge, increase cooperation and improve communication by translating differences in organizational culture or language (Abrutyn, 2012; Akkerman and Bakker, 2011; Linden, 2002; Long et al., 2013). Because of their unique situation, boundary workers must take multiple perspectives and mediate conflict when necessary (Akkerman and Bakker, 2011; Long et al., 2013). The result of boundary work is the transfer of best practices and the synthesis of information to create new practices in the "third space" between groups (Siegel, 2010).

A wide variety of challenges to collaboration exist at the boundaries which separate people and organizations. Participating parties may enter collaborations with conflicting missions, interests, or viewpoints, as well as differences in resources, power, or status (Cordeiro and Kolek, 1996; Linden, 2002; Sandholtz and Finan, 1998). Broadly, the related literature indicates that the presence of a "boundary-worker" enhances the ability of developing scientists to successfully navigate boundary challenges and attain more favorable results. Burrows et al. (2009), conceptualize graduate student participants in a science outreach program as boundary-workers functioning as a "pivot point among high school and university educators, high school students and the university research environment" (p. 5). The coordinating faculty of such programs could certainly also be considered boundary-workers, as McMillan (2011) notes in her discussion of service-learning coordinators. These individuals have a critical influence on participants' experiences.

In addition to boundary-workers, "boundary objects" such as a collaborative vision statement, program expectations and standard operating procedures, prove helpful in easing communication across the boundary (Akkerman and Bakker, 2011; Clark et al., 2011; Dolan et al., 2004; Kimble et al., 2010; Star and Griesemer, 1989). Some examples of boundary objects employed in science education outreach programs include but are not limited to jointly produced curricula, evaluation plans, program descriptions, collaborative planning documents and research documents (Burrows et al., 2009; Crone et al., 2011). Sometimes boundary objects can simply be a set meeting schedule and agenda. As one collaborator notes, "*it helped that we had structured activities that put us in close contact to share responses*" (Leone, 1998 in Kezar, 2007, p. 29). Both organizational and individual learning can be facilitated by boundary objects (Daniels, 2004).

The remaining sections of the paper apply the concepts of experiential learning, legitimate peripheral participation, and activity theory to the description of an outreach program that could be utilized to build the outreach and teaching knowledge and skills of graduate students through just-in-time instruction and authentic outreach experiences. These efforts are situated within the cultural contexts of science education reform and the mission of land grant institutions of higher education. Cooperation invites a number of boundary-crossing processes between members of the higher education and K-12 or informal education communities. When graduate students become involved in such efforts, they become legitimate peripheral participants in this larger activity system. A review of the contexts, challenges, and "map for success" in science education partnership efforts is provided in the subsequent sections.

The Need for Agricultural and Scientific Literacy

The turn of the 21st century has been characterized by mounting calls for increased public literacy in science and agriculture as well as education reform to improve student outcomes and increase the future STEM and agriculture work-force. We are approaching the 30-year anniversary of the publication of "A Nation at Risk," the first major public call for education reform since the Sputnik era. This report highlighted disappointing performances of U.S. youth and adults in areas of basic literacy, numeracy and scientific understanding as compared to our global competitors (Gardner et al., 1983). This publication is credited with the dawn of high stakes testing, but also spurred reform in the formation of the National Science Education Standards, which increased the emphasis on science as a process of inquiry as opposed to a collection of fact (Buxton and Provenzo Jr, 2011; National Research Council, 1996).

The cry was mounted again in 2007 with "Rising above the Gathering Storm," which highlights the rising prevalence of European Union and Asian Pacific Economic Cooperation nations in science and technology as well as growing trade imbalances, stagnating public funding for science and the disappointing performance by American students as compared to students from other developed nations on national and international math and science performance assessments. In the 2005 National Assessment of Educational Progress (NEAP) science assessment, only 32% of 8th graders and only 18% of 12th graders scored at or above the "proficient" level. The performance of American 12th graders on the 1999 TIMSS and 2006 PISA were particularly discouraging (National Academy of Sciences, 2007). PISA averages for American 15 year-olds in 2012 were not measurably different than in previous years, which beg the question – if the U.S. spends 39%

more per student than the average member nation in the Organization for Economic Co-operation and Development (OECD), the pool from which PISA scores are taken, why are our students consistently scoring at or below average? (Kelly et al., 2013).

Relative deficits at the K-12 level translate to the adult population. Though science literacy among American adults showed an increasing trend in 2007, with 28% of adults demonstrating basic science knowledge, a 2014 report from the National Science Foundation (NSF) indicated that science literacy had stabilized (National Science Foundation, 2014). Though the majority of adults who responded to the 2012 NSF survey held positive views about science, many struggled to respond to elementary science questions, showed an incomplete understanding of the nature of scientific knowledge and showed declining interest in socio-scientific issues such as stem cell research, climate change and environmental quality (National Science Foundation, 2014).

Interest in science careers is also a concern. Though it is widely recognized that the need for a highly-trained scientific workforce is on the rise, data presented in Rising above the Gathering Storm indicated that the number of undergraduate and graduate students enrolling in STEM fields had remained relatively stable over the last several decades and was predicted to level off in the coming years (Bybee and Fuchs, 2006; National Academy of Sciences, 2007). Over the past decade, graduation rates in STEM have improved, but recruitment and retention – especially of women and minorities – remain a high priority for the field (Gonzalez and Kuenzi, 2012). The 21st century push for science education reform has resulted in the recent release of a new set of standards for science education. The Next Generation Science Standards incorporate increased emphasis on engineering design and the relevance of science to social issues, thus increasing the relevance of the applied sciences in the hopes of preparing students for a wide variety of 21st century careers (Achieve, 2013).

The call to action in the agricultural sector mirrors that of the science community, with a rising call to integrate STEM competencies into the K-12 career and technical agriculture classroom (Myers and Washburn, 2008; Spindler, 2015; Warnick et al., 2004; Williams and Dollisso, 1998). Like Rising above the Gathering Storm, the 2009 National Academy of Sciences report Transforming Agricultural Education for a Changing World emphasizes the need to recruit students into the agricultural sciences, especially women and minorities. It highlights the need to integrate high-quality agricultural and STEM education to address critical challenges in the field – particularly the globalizing economy, the rise of "scientific agriculture," and the increase in systems-based thinking to address pressing issues such as food security, climate change and environmental quality. However, with less than 20% of the U.S. population growing up in rural communities, agricultural literacy and workforce development is even more pressing an issue than science literacy and recruitment into STEM fields (National Academy of Sciences, 2009). In support of the Academy's report, Kovar and Ball (2013) reviewed the research on agricultural literacy over the last 20 years and found that 17 out of 23 studies across a variety of populations identified deficiencies, the greatest of which were among K-12 students and teachers.

With the wealth of possibilities for application and experiential learning of scientific concepts, the K-12 agricultural classroom is increasingly seen as complimentary to the science classroom in advancing science literacy goals. (Myers and Washburn, 2008; Parr and Edwards, 2004; Young et al., 2012). Common themes among reports outlining the need for science and agricultural literacy include (1) the complexity of current socio-scientific issues requiring 21st century professionals to possess the higher-order thinking and scientific reasoning skills to address them, (2) the prevalence of science, technology, and agriculture in daily life, demanding an appreciation for and understanding of these fields for informed citizenship and (3) the importance of public and policy-maker understanding of science and agriculture to create a cadre of advocates to enhance public funding and political support for research and development (Crone et al., 2011; Doerfert, 2011). Enhancing education at all levels is broadly embraced as a "systematic way" (Dolan, 2008) to address the issues of scientific and agricultural literacy and is reflected in the most recent strategic plans of the Virginia Cooperative Extension System and the American Association of Agricultural Educators, among others (Doerfert, 2011; Virginia Cooperative Extension, 2010). Though training a technologically capable work force to secure the nation's economic prominence is still a significant driving force behind science literacy initiatives and education reform, the need to build an informed, caring citizenry with the critical thinking skills to address 21st century socio-scientific issues is increasingly emerging as a motivating factor (McFarlane, 2013; Partnership for 21st Century Skills, 2011; Williams and Dollisso, 1998).

The Case for Agricultural and Science Education Outreach

The National Science Foundation responded to the call for increased science literacy by revising their grant proposal guidelines in 2000 to include "broader impacts" criterion; requiring NSF funded projects to indicate direct societal impact or to share discoveries with the wider public through *"improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others"* (National Science Foundation, 2013). Around this same time, the NSF initiated their two signature outreach projects - the Graduate STEM Fellows in K-12 Education Program (GK-12), which was founded in 1999 and the Math and Science Partnership (MSP) program, which funded its first projects in 2002.

The former connects STEM graduate students with K-12 teachers to develop and deliver curriculum relevant to both the graduate students' research and state learning standards. The latter connects scientists with teachers for a wide variety of projects; including "scientist-in-the-classroom" programs and professional development workshops for teachers by scientists (National Science Foundation, 2015a, 2015b).

As mentioned in the introduction, the renewed push to connect the university to the public is not unique to the STEM fields, but spans all academic sectors (Cordeiro and Kolek, 1996; Kinpaisby, 2008; McMillan, 2011; Siegel, 2010). Public forces that influenced this resurgence include the 1999 Kellogg Commission on the Future of State and Land-Grant Universities report, Returning to our Roots: The Engaged Institution, the American Association of State Colleges and Universities Tools and Insights for Universities Called to Regional Stewardship report published in 2006 and the 2007 Carnegie Community Engagement Classification System (Siegel, 2010). Notable discussions around this time included the Committee on Institutional Cooperation and the National Forum on Higher Education for the Public Good meetings in 2002 which resulted in an agenda to reduce the alienation between higher education and society (Bagdonis and Dodd, 2010). These discussions brought up the need to return to the original land-grant mission of service to the public and created ranking and incentive systems to reward institutions for public service (Siegel, 2010). Kindon et al.(2008) note that the role of university faculty is increasingly being re-envisioned from a one-way creator of knowledge to a working community partner engaged in two-way learning with professionals and citizens outside the institution.

Given that renewed calls for science education reform and public scholarship converged at the turn of the 21st century, the shift toward supporting higher education science outreach is not surprising. As a result, the past decade and a half has seen an explosion of science outreach and engagement projects across a variety of settings, from museums and nature centers to K-12 schools, universities and national research laboratories (Foster et al., 2010; Montano, 2012). As Figure 2 illustrates, Dolan (2008) places outreach activities on a spectrum from "awareness" to "partnership," and advocates for a high level of teacher involvement (i.e. partnership) to maximize benefits for all parties involved. Typical outreach formats include: "scientist in the classroom" initiatives; technology programs, field trips, citizen science projects, summer science internships or camps, "Saturday science" programs and teacher professional development.

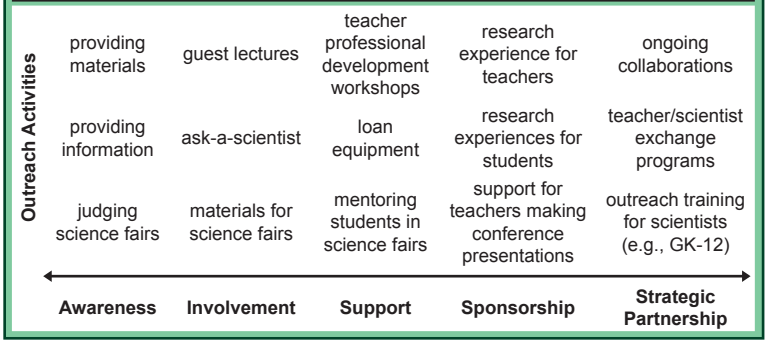
There are a variety of purposes for science outreach, but the most predominantly cited goal is to impact K-12 students' understanding of and interest in science through "authentic" learning (Bruce et al., 1997; Burrows et al., 2009). Predominant agendas for science outreach include the recruitment of the next generation into STEM fields and addressing public misconceptions about science (Besley et al., 2015; Bruce et al., 1997; Burrows et al., 2009; Pecen et al., 2012). Constructivist philosophy dominates the pedagogy of science outreach education, as the majority of programs emphasize "hands-on" or "inquiry-based" strategies for communicating scientific content, working from the standpoint that students learn best by experience (Bruce et al., 1997; Burrows et al., 2009; Collins, 2011). A secondary agenda for outreach, mentioned by Wellnitz et al. (2002) and Dolan (2008) is the obligation of universities to serve their communities. Broadly speaking, outreach presents a compelling way for colleges of science to live up to their public service mission while assisting with the advancement of science education reform efforts and addressing public science literacy issues that are of concern to them as professionals (Crone et al., 2011; Kinpaisby, 2008; Montano, 2012).

In the realm of agriculture, science outreach has become a strong focus of the Cooperative Extension Youth Development (4-H) program and some of 4-H's national "signature" programs connect students to scientists vis à vis citizen science projects and science fairs (National 4-H Council, 2014a; Virginia Cooperative Extension, 2010). However, formal, funded programs that directly connect agricultural scientists to youth through partnerships such as GK-12 and MSP are rare in the literature, as compared to engineering, physical science, earth science, or biological science-based projects. Within Colleges of Agriculture, the majority of K-12 outreach activities tend to be concentrated within social science departments: agricultural education, leadership, communication and economics (Bagdonis and Dodd, 2010). The apparent lack of "scientist-in-the-classroom" engagement in the agricultural sciences relative to other areas presents a significant missed opportunity for Colleges of Agriculture to capitalize on the "outreach imperative" in science education.

Successes and Challenges of Outreach

Science outreach programs have shown measurable success in achieving their stated goals of improving science education (Bruce et al., 1997; Kirwan and Seiler, 2005). In particular, Foster et al. (2010) and Zhang et al. (2011) evaluated the NSF-MSP program and found that science outreach activities by scientists improved

Figure 2: The continuum of university-based K-12 education outreach and engagement activities. Reprinted from Education, Outreach, and Public Engagement by E. L. Dolan, 2008, p. 2, Copyright 2008 by Springer Science and Business Media, LLC.



teachers' understanding of science content and processes as well as their confidence in teaching science via inquiry-based methods. They also found that student achievement in science improved for classes involved in MSP sponsored programs. Generally, teachers are welcoming of the content expertise, enthusiasm and positive role-modeling that scientists bring into their classrooms (Bruce et al., 1997; Collins, 2011). Outreach also presents a singular opportunity for scientists to accrue new ideas about teaching and learning and to rekindle personal excitement about their own work (Dolan et al., 2004; Foster et al., 2010; Zhang et al., 2011). In their study of a teacher-scientist collaboration project, Munson et al. (2013) extensively reviewed the literature on the benefits for both teachers and scientist of outreach projects and found similar results.

The prevalence and success of many science outreach programs might lead one to believe that the process of connecting scientists to schools is simple. Because there is the common focus on education, the collaboration between universities and schools or non-formal educational institutions should be natural. However, regardless of the sector – even in relationships between collegiate-level departments of education and K-12 schools – differences in institutional culture can become a significant barrier (Bouwma-Gearhart et al., 2014; Dolan et al., 2004; Kezar, 2007; McMillan, 2011; Restine, 1996; Tsui and Law, 2007). Some of these cultural differences include the pace of school vs. university life; limitations to time and resources, and differing priorities for student learning. Restine (1996) also notes that there is often a wariness of the "academic elitism" sometimes portrayed by members of the higher education community. Differences in working vocabulary, noted by Dolan et al. (2004), serve as an additional barrier to science outreach efforts.

Indeed, simplifying the "language of science" is a frequently-cited challenge to scientists engaged in outreach work (Crone et al., 2011; Montano, 2012; Star and Griesemer, 1989; Zhang et al., 2011). This is related to and complimented by frequent criticisms of the lack of pedagogical expertise on the part of scientists (Christodoulou et al., 2009; Collins, 2011; Nilsen, 2013; Zhang et al., 2011). When conducting outreach, scientists are often expected to engage students in inquiry-based learning, even though their training and home teaching style is most likely to be lecture-based (Doerfert, 2011; Dolan, 2008; National Academy of Sciences, 2009). It has become apparent that academics could benefit from increased knowledge of teaching and learning in order to be truly effective communicators to the public as well as exemplary instructors of budding scientists and the undergraduate and graduate level (Bouwma-Gearhart et al., 2014; Crone et al., 2011; Dolan et al., 2004).

A final barrier that presents itself to faculty getting involved with outreach is time. Amidst demands for high-quality research productivity and myriad other institutional responsibilities such as teaching, advising and committee work, outreach may be seen as an "add on" to which faculty are unable to dedicate sufficient attention for success (Foster et al., 2010). Outreach activities seem to be most successful when the participating faculty are (a) passionate about the cause and (b) well-supported by their institution or other funding (Dolan et al., 2004; Zhang et al., 2011). Changes in promotion and tenure policies to reward outreach activities are gaining popularity as a solution to this problem (Dolan, 2008; National Academy of Sciences, 2009)

Therefore, for science outreach activities to be successful, it is necessary for scientists to have sufficient training and support in order to negotiate the boundaries between the university and K-12 environments. Evaluators of outreach and partnership programs have identified two primary ways to achieve this support. Some institutions offer professional development workshops for scientists on the topics of communication, pedagogy, and outreach techniques either separately or in conjunction with outreach programs (Besley et al., 2015; Dolan et al., 2004; Foster et al., 2010). In addition, Dolan et al. (2004), Burrows et al. (2009) and Bouwma-Gearhart et al. (2014) emphasize the importance of resource professionals who are able to translate across both the theoretical and physical communities of education and science. These individuals are familiar with scientific culture and the process of science, but are also well-versed in education theory and practice. They also possess the interpersonal savvy to mediate between the two communities and create a productive, collaborative learning environment (Bouwma-Gearhart et al., 2014). Whether serving in a formal or informal capacity, the majority of partnerships rely on one or more of these "boundary workers."

Zhang et al. (2011) describe the traits that make STEM faculty successful outreach partners. In addition to possessing *"a high quality disciplinary background and credibility,"* successful outreach faculty are also good instructors and are interested in how to teach more effectively. They are student-centered and believe in the goals of outreach changing the lives of students. In addition, they are open-minded to trying new approaches, and are willing to work in teams. Finally, successful STEM outreach faculty are able to *"meet people where they are" in terms of content-level foundations, and are "in touch with their inner adolescent."* In short, successful outreach partnerships require science faculty to be supported by effective boundary workers or to be boundary workers, themselves. The question then presents itself – given the growing demand for such programs, how do we produce more successful boundary workers to facilitate successful outreach projects?

Involving Graduate Students in Outreach

The push for increased public engagement by Institutions of Higher Education (IHE) has significant implications for the way beginning scientists at our colleges and universities are being trained (Siegel, 2010; Wellnitz et al., 2002). In response to this renewed interest in bringing the university to the public, some IHE's have begun to enact changes in their promotion and tenure policies

to reward quality teaching, outreach and engagement in addition to research (Dolan, 2008; Foster et al., 2010; National Academy of Sciences, 2009). However, one of the major critiques of graduate education, today, is that students' training emphasizes specialized research and technical skills while neglecting preparation in other faculty roles, such as teaching, advising, civic engagement and public scholarship (Austin, 2002; Bagdonis and Dodd, 2010; Crone et al., 2011; Pew Charitable Trusts, 2001; Tanner and Allen, 2006).

Pew Charitable Trusts (2001) surveyed nearly 10,000 graduate students and found that the majority felt unprepared for the realities of future careers both within and outside of academia. As the result of a four-year qualitative study of graduate students' socialization into the professoriate, Austin (2002) developed recommendations for more holistic graduate training. Some of these recommendations include proving opportunities to (1) develop deep knowledge and a personal philosophy of teaching and learning (2) learn about institutional service and public outreach (3) learn how to engage in interdisciplinary work or collaborate with partners outside of academia and (4) learn how to communicate with the broader public. Transforming Agricultural Education echoes Austin's (2002) recommendations, and others note that the issue of graduate student training is just as pressing in the agricultural sciences as in any other field, if not more so (Bagdonis and Dodd, 2010; Doerfert, 2011; National Academy of Sciences, 2009).

Faculty participants and evaluators of science outreach initiatives recommend strongly that training in outreach begin at the graduate level (Munson et al., 2013). As such, this is a major goal of the GK-12 program and similar "scientist-in-the classroom" initiatives that involve graduate students, to include the Graduate Extension Scholars program (Buck et al., 2006; Scherer and Jamison, 2014). When funded opportunities are not available, graduate students are increasingly taking advantage of volunteer opportunities to fill in the gaps in their formal training and prepare themselves to be effective educators and advocates as well as researchers (Foster et al., 2010; Montano, 2012). Engagement at the graduate level is therefore seen as a key piece to the puzzle for changing the culture of academia to better support outreach efforts and elevate the quality of undergraduate teaching (Burrows et al., 2009; Crone et al., 2011; Wellnitz et al., 2002).

Graduate students, however, face the same challenge as faculty in communicating science. Christodoulou et al. (2009), Crone et al. (2011), Collins (2011) and Nilsen (2013) found that graduate students struggled to simplify scientific language and effectively employ inquiry-based techniques in the K-12 setting. Given their training agenda, the majority of graduate-level science outreach programs are therefore highly-structured to provide support for learning and development of practice. In some programs, this consists of a pre-outreach training workshop (Collins, 2011; Montano, 2012). Other programs gather students for weekly or monthly planning meetings (Christodoulou et al., 2009; Wellnitz et al., 2002). Still others structure outreach activities and associated training as part of a formal, credit-bearing course or seminar via which faculty and guest speakers address the various aspects of education theory; from achievement standards and pedagogical philosophies to lesson planning, assessment and group management (Burrows et al., 2009; Christodoulou et al., 2009; Crone et al., 2011).

The basic premise behind structuring outreach programs in this way is to create a community of practice among graduate student participants and their faculty mentors around outreach education (Buck et al., 2006; Crone et al., 2011). Action is combined with opportunities for reflection based on Dewey's perspective that "educative experiences… are imbued with anticipation, development, and unity" (Christodoulou et al., 2009). Workshops, seminars, or coursework provides a scaffold for the experience of conducting outreach, allowing participants to complete the experiential learning cycle (Crone et al., 2011; Kolb, 1984). Authentic experience designing, delivering, and evaluating outreach activities is a critical component, as is training and support. "Glossing over" one or the other has negative ramifications for the success of graduate student learning and the effectiveness of the outreach they conduct (Collins, 2011; Crone et al., 2011).

Because a critical agenda of outreach training programs for graduate students is to socialize them into a community of science faculty, view graduate students as legitimate peripheral participants in this community. Their participation in outreach programming can be viewed as a part of a "dialectic of practice," by which they are obtaining a layered identity as educators and scientists which may in turn influence practice of the scientific community (Buck et al., 2006). Henceforth, graduate students participating in outreach programs are not only seen as "outreach educators in training," but as "scientists in training" and as potential change agents in the advancement of public engagement by the scientific community. Many programs aim to help graduate students incorporate outreach into their professional identities (Burrows et al., 2009; Crone et al., 2011; Montano, 2012; Wellnitz et al., 2002).

From the apprenticeship perspective, meaningful engagement with experts as well as fellow newcomers is critical to the formation of professional identity and advancement to full membership in a community of practice, not to mention the acquisition of the practical skills necessary for expertise (Lave and Wenger, 1991; Pratt, 1998). Thus, social relationships are a critical component of the outreach training process. Workshops, meetings, courses, or seminar sessions give graduate student participants an opportunity to self-reflect, self-evaluate and deepen understanding among peers (Buck et al., 2006; Crone et al., 2011). However, just as important to the learning process appears to be the mentoring relationships that participants build with community partners, program coordinators and their faculty advisors

through involvement with the outreach project (Burrows et al., 2009; Montano, 2012). Specifically, Burrows et al. (2009) and Buck et al. (2006) emphasize the importance of a supportive research advisor in the success of GK-12 program fellows. However, if the students' faculty advisor does not have a direct role in the outreach project, programs can enhance success by providing direct mentoring from other faculty who are outreach experts and are involved in the outreach project (Buck et al., 2006; Burrows et al., 2009; Collins, 2011).

In essence, it is critical that graduate students have the support of established scholars within the academic community who share their values around the importance of outreach education. These mentoring relationships can help to mitigate the challenges graduate students often experience around adjusting to the K-12 culture, learning "how to teach," figuring out how to make explicit links between their research and the K-12 curriculum, balancing personal and professional conflicts and dealing with the pressure of keeping up with research responsibilities in the midst of the time commitment that outreach requires (Buck et al., 2006; Burrows et al., 2009). Advisor support and time constraints continue to be significant barriers that can be eased by funding, but not eliminated (Crone et al., 2011; Montano, 2012). Therefore, for the foreseeable future, outreach programs for graduate student scientists are likely to attract students who already see the value of outreach education and who believe in this cause (Buck et al., 2006; Crone et al., 2011).

However, even if providing training at the graduate level does not necessarily "win" new students over to outreach, it does create a supportive environment that may allow outreach-inclined scientists to increasingly persist in that work (Burrows et al., 2009; Montano, 2012). Such programs help graduate students understand the realities of teaching, planning and working with stakeholders (Burrows et al., 2009; Crone et al., 2011). They also report enhanced time management skills, a helpful attribute to future faculty balancing a demanding lifestyle (Austin, 2002; Burrows et al., 2009). The majority of graduate students who participate in outreach programs report feeling better prepared to teach and more confident in their communication and evaluation skills (Burrows et al., 2009; Crone et al., 2011; Montano, 2012). Others express that their experiences with outreach encouraged them to bring more inquiry-based and hands-on techniques into the formal science classroom (Bruce et al., 1997). However, some note that the outreach environment is highly contextual and not entirely transferrable to undergraduate teaching (Buck et al., 2006).

In terms of benefits for K-12 educators and students, outreach programs that center on graduate students enjoy similarly positive reviews to those that engage professional scientists. Teachers value the enthusiasm and resources that graduate students bring into the classroom, extending the curriculum and enhancing science learning for students (Bruce et al., 1997). Graduate students serve as a 'bridge' of sorts between school-aged students and the scientific community. Not being far out of school, themselves, they often serve as effective role-models for younger students (Burrows et al., 2009; Collins, 2011). Placing emphasis on collaborative partnership with teachers, assessing and prioritizing their needs and consistently evaluating and re-configuring outreach efforts enhances benefits to K-12 teachers and students while also teaching graduate students about the iterative nature of program planning and design (Crone et al., 2011; Dolan, 2008; Dolan et al., 2004; Wellnitz et al., 2002).

Conclusions, Implications, and Recommendations

As evidenced by the literature from science education, engaging graduate students in outreach has significant potential for addressing national education-reform agendas at both the K-12 and higher education levels. When scientists are provided with sufficient support and training, they can serve as valuable partners in the enhancement of public scientific literacy and K-12 science education. However, the need to build bridges between the scientific and educational communities before engaging in outreach activities cannot be underestimated. Engaging scientists in outreach early in their career development has the potential to expand the "outreach contingent" and equip the scientific workforce with individuals who are able to bridge those gaps.

Preparation of graduate students in outreach and engagement is relevant to the agricultural science community for numerous reasons. Given the expanding global population and prevailing struggles with climate change, environmental degradation and rural community development, agricultural scientists are uniquely positioned as problem-solvers around food security, clean water, alternative energy and natural resources management. Calls for K-12 education reform are "zeroing in" on the need to address socio-scientific issues, the majority of which have connections to the agricultural and life sciences (Achieve, 2013; McFarlane, 2013). Increasingly, inter-departmental partnerships between K-12 science and agricultural education programs, as well as between K-12 science classrooms and informal programs like 4-H are seen as pathways for achieving science education goals (Myers and Washburn, 2008; Pellien, 2014; Spindler, 2013; Warnick et al., 2004). Agricultural scientists are particularly qualified from a content standpoint to assist in such initiatives.

National agendas for agricultural education emphasize the importance of engaging agricultural professionals in outreach to enhance public understanding of critical agriculture-related issues such as climate change, food security, energy security, community economic development, nutrition and environmental stewardship. Effectively "getting the message out" has implications for public policy and the recruitment of the next generation of agricultural scientists (Doerfert, 2011). Because the K-12 school system provides the pipeline to higher education, programs targeting this population have the

potential to play an important role in addressing these issues (National Academy of Sciences, 2009). Furthermore, by better integrating STEM content and understanding of the scientific process into agricultural curricula at the K-12 level, agriculture educators have the potential to simultaneously assist in addressing national agendas for science education as well (Doerfert, 2011; Myers and Washburn, 2008; Warnick et al., 2004).

Up-to-date and STEM integrated curriculum requires that agricultural educators be in-touch with current research in the agricultural sciences (Doerfert, 2011). In this respect, as in the other STEM fields, engaging scientists in outreach has significant potential. Some programs that connect K-12 students and teachers with agricultural scientists, exist, but they are not as prevalent as in other STEM fields. Indeed, it has been found that – similarly in other STEM fields – there is a significant lack of opportunity for agricultural scientists in-training to practice communicating with K-12 schools and the public, even though their future careers may require them to do so (Bagdonis and Dodd, 2010; National Academy of Sciences, 2009). Those agricultural outreach programs that do exist have shown success in enhancing science learning, as well as outreach competency on the part of participating agricultural science graduate and/or undergraduate students (Gardiner, 1991; Kirwan and Seiler, 2005; Smith et al., 2014). Expanding opportunities for budding agricultural scientists is relevant to national agendas for agricultural education reform at all levels, promoting the American Association for Agricultural Educations' priorities to enhance *"meaningful, engaged, learning in all environments"* and *"efficient and effective agricultural education."* (Doerfert, 2011).

Understanding how graduate students learn and develop professional identities as legitimate peripheral participants in a dialectic community of practice could enhance the effectiveness and prevalence of outreach programs. More research in this area can help professionals in colleges of agriculture determine factors that motivate and support graduate students to engage in outreach, ingredients necessary to produce a quality outreach product that is beneficial to the K-12 community, and produce deep learning on the part of graduate student about the art and science of teaching and public engagement. Drawing inspiration from the literature on outreach in other STEM fields can provide a model from which to base agricultural outreach efforts.

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An Examination of a Graduate Learning Community in a College of Agriculture

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Abstract

Graduate learning communities have the potential to assist graduate students in integrating both academically and socially into their graduate programs through curricular and extracurricular activities. At Texas A&M University, a graduate learning community was created in the College of Agriculture and Life Sciences to help diverse graduate students integrate into their graduate program. This study sought to describe experiences of this first-year graduate learning community in a college of agriculture focused on retention of graduate students, successful integration into graduate school and leadership and research skills. Interviews were conducted with eight graduate students who completed one year of a graduate learning community to gain an understanding of what students gained from their experience. Graduate students described the learning community through two themes: most meaningful experiences and least meaningful experiences. Regarding suggestions for enhancement for future students, themes of structure/content and social interaction were found. Students reported social interactions were one of the most meaningful components of the learning community, but more social interaction was a recommendation for future learning communities.

Introduction

An average of less than 60% of students who start a PhD complete their program across disciplines, however, life science students tend to have a slightly higher completion rate than other fields of study (Sowell, 2008; Sowell et al., 2015). Six institutional and program characteristics emerge, however, as key factors influencing student outcomes that can ultimately affect the likelihood that a particular student will complete a PhD program: Selection, Mentoring, Financial Support, Program Environment, Research Mode of the Field and Processes and Procedures (Sowell, 2008).

Master's student completion rates were higher as 66% of STEM master's students completed their program of study at the end of four years (Council of Graduate Schools, 2016). Women master's student completion rates for STEM programs were higher than those of men (Council of Graduate Schools, 2016). Interestingly, this seems to contrast the findings from a study Berg and Ferber (1983) conducted that found women's graduate school attrition rates were higher than men. For master's students, the two most important contributing factors to completing their programs were motivation and non-financial family support. Subsequently, interference from employment was the number one factor to master's student non-completion of their programs (Council of Graduate Schools, 2016).

Tinto's persistence model posits that academic and social integration are key to graduate student success or failure (Tinto, 1993). According to this model, academic and social integration influence the commitment that students have to their goals while in graduate school. Academic integration involves both technical understanding of students' content areas as well as general writing and communication skills. Social integration involves graduate students finding acceptance within their department, college and university (Tinto, 1993). Social integration involves students making friends with other students on campus, experiencing the college campus by spending time on it and having an overall satisfaction with their social experiences (Smith and Bath, 2006; Li et al., 1998). Graduate learning communities have the potential to address both academic and social integration through their curricular and extracurricular activities.

Learning communities have been described as intentional environments where each program, activity and interaction within the community is orchestrated to build upon the primary learning goals of the group (Brower and Dettinger, 1998). At its very basic state, a learning community is a group of people coming together who share and are pursuing specific learning goals (Brower and Dettinger, 1998). Zhao and Kuh (2004) listed several benefits that undergraduate stu-

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dents experienced while participating in learning communities. They conducted an empirical study, which found that *"learning communities are associated with enhanced academic performance, integration of academic and social experiences, gains in multiple areas of skills, competence and knowledge and overall satisfaction with the college experience"* (Zhao and Kuh, 2004, pp.130-131). However, while learning communities have been researched and examined intently at the undergraduate level, the literature on graduate level learning communities is scant. Romsdahl and Hill (2012) transferred successful practices and principles from undergraduate learning communities to their graduate learning communities in the ESSP program. Additionally, the students who participated in the ESSP learning community noted a variety of benefits including improved teamwork and research skills, reinforcement and linkage of course concepts and creative and academic value in the tangible products (Romsdahl and Hill, 2012). Research on graduate learning communities is addressed in the next paragraphs. Krasksa (2008) investigated graduate learning communities to understand their benefits, limitations and components.

Based on a review of previous literature, Brower et al. (2007) identified four key elements of a learning community—shared discovery and learning, functional relationships, inclusive learning environments and connections to broader learning experiences across campus with two outcomes of changed identity and sense of ownership over the community. Brower et al. (2007) described a graduate learning community (called the Delta learning community) used to address the challenge of the conflict between learning to teach and learning to conduct research and helping graduate students connect their research and teaching interests. The Delta learning community integrated the four key learning community elements, but Brower et al. (2007) concluded that more evaluation was needed to track broader impacts for this learning community.

Kraska (2008) outlined several models of learning communities that impact retention of undergraduate and graduate students: freshman interest groups, graduate interest groups, skill and content linking group and coordinated studies graduate learning model. Each of the models bring students together, who share a set of common interests, challenges and opportunities to form a community that promotes success in their respective fields of study. Kraska (2008) relied on previous research and literature, which suggested that integrating students with other peers and instructors may increase their retention rates. Kraska (2008) also referenced studies that indicated higher grades and satisfaction levels (with their educational experience) for those students who participate in learning communities. Kraska posited that for models of learning communities to be considered effective they must *"promote shared learning and discovery, involve inclusive learning environments and form connections that extend learning across the campus"* (Kraska, 2008, p. 65). Kraska (2008) noted learning communities appear to be overall effective based on literature and research, but more research is needed to fully assess the value and potential of learning communities at various educational levels and academic disciplines.

Romsdahl and Hill (2012) applied principles from undergraduate learning community models to a graduate learning community setting. Using a coordinated studies learning community model, their study involved several cohorts (communities) of graduate students in an Earth System Science and Policy (ESSP) graduate program. They followed the learning community model outlined by Kraska (2008) that encompasses five core practices: community, diversity, integration, active learning and reflective assessment. Each cohort of students took part in the same blocks of classes and activities for one year to build a solid foundational understanding of their field of study. Along with building their knowledge base, the students fostered community and collaborated on purposeful, team-building projects that aided in their understanding of the material they studied. Because scant research exists on graduate learning communities, an evaluation of graduate learning communities is needed (Brower et al., 2007; Kraska, 2008), this study sought to evaluate a graduate learning community.

At Texas A&M University, a graduate learning community was developed to support the transition of graduate students entering the College of Agriculture and Life Sciences. This two-year learning community was targeted at diverse populations with a focus on retention, success, timely progress towards degree and developing leadership and mentor/mentee skills. This study sought to determine the perspectives of students who completed their first year of the graduate learning community. The researchers wanted to understand what graduate students benefitted the most and least from during their experience, how the learning community contributed to their transition to graduate school and identify recommendations for changes to the learning community in future years.

Purpose and Research Questions

The purpose of this study was to describe the experiences of a first-year graduate learning community focused on retention of graduate students, successful integration into graduate school and leadership and research skills. The specific questions which guided this study included:

1) How do members of the graduate learning community describe their experiences in the learning community?
2) How can the graduate learning community experience be enhanced in future years?

Methods

The Institutional Review Board at Texas A&M University approved the study protocol. A basic qualitative method was used because this study focused on gaining the personal perceptions of individuals (Merriam, 2009).

The population for this study was graduate students who participated in a graduate learning community in the College of Agriculture and Life Sciences at Texas A&M University. A purposive sample with a criterion base of graduate students who were members of the graduate learning community during the 2013-2014 academic year were participants in this study. There were eight graduate students who consented and participated in this study.

Context for the Study

For purposes of this learning community, diversity was a broad term defined as students who self-identified as African-American, Hispanic, or American Indian/ Alaska Native. Additionally, it included students from the following areas: minority groups that have been historically under-represented at Texas A&M University or certain professions, first generation college students, persons with disabilities and veterans. There were eight participants in this study, six doctoral students and two Master of Science students. Three of the participants were male and five were female. Participants volunteered to participate, but were not required as part of the learning community agenda. There were several disciplinary focuses among the participants including agricultural economics; plant pathology; animal science; bio-agricultural engineering; and agricultural leadership, education and communications. All eight of the participants exhibited at least one of the characteristics of diversity previously mentioned. The learning community was led by a graduate administrator in the college and an assistant professor of leadership in the college. Graduate students in the learning community were selected at the college level based on recommendations by their department. There were 15 participants in the first year of the program. Graduate students were asked to join the learning community and as a benefit of joining and participating in the learning community, they were offered a small grant to cover a professional development event of their choice. Examples of professional development opportunities included but were not limited to: scientific society meetings, research conferences and symposiums. Students had to apply to receive the professional development grant and had to attend learning community events on a regular basis to be eligible to receive the funding.

Programming for the learning community consisted of meetings once a month where students and leaders met for food and to discuss a topic related to graduate school transition or leadership development. Specific topics of discussion included: work ethic and culture of graduate school, considerations for success, the written and unwritten expectations of graduate students, how culture and expectations differ by fields of study and type of research, appreciation of different research approaches (quantitative vs. qualitative, wet bench vs. field, biological vs. social science, etc.) and leadership assessment of self (SWOT personal career analysis, StrengthsFinder and personality). Graduate students also were required to attend a personal development event that enhanced their graduate education. Examples consisted of grant and research writing workshops, research presentations and teaching workshops.

Data Collection and Analysis

Data was collected by semi-structured interviews with each student that lasted 30 to 45 minutes. Follow-up interviews were also conducted to obtain further perspectives from some individuals. Each student interview was assigned a code to maintain the confidentiality of their statements. The constant comparative method was used for data analysis (Glaser and Strauss, 1967). Interviews were coded as LC1 through LC8. The researcher studied the field notes and categorized trends from the data to arrive at themes.

Member checks were conducted to address credibility. Each person participating in the study was emailed a copy of the field notes from their interview (Merriam, 1998) and asked to ensure the researcher captured their experiences accurately and robustly. A peer debriefing was also conducted with another researcher to ensure the information collected captured the essence and purpose of the study (Merriam, 1998). After peer debriefing, follow-up interviews with some of the participants were conducted. Dependability and confirmability of results were established by the researcher developing an audit trail and keeping detailed records of the data collected and analysis procedures in a reflexive journal (Merriam, 1998).

Findings

When asked to describe the learning community, one student said *"it is a support system that helps us get through grad school [by] equipping and supporting us to complete grad school as effectively and enjoyably as possible"* (LC6). Another student said that the learning community offered a way for students to connect, share experiences and have support from each other and from professors (LC3). Students listed ways the learning community was helpful to them as part of the various exercises and discussions they participated in throughout the year. One student said the biggest thing she learned from the formal meetings was managing time and commitment. *"We did a lot of talking about how to balance time and commitment"* (LC6). LC2 said the learning community generally *"could help me be a successful graduate student by being able to communicate with my advisor and fellow colleagues better"* (LC2). Two themes primarily emerged when students were asked to describe the experience they had in the learning community: most meaningful experiences and least meaningful experiences.

Most Meaningful Experiences

Students in the learning community shared some of the experiences they had that were most meaningful to them during their time as a participant. The experiences that were most meaningful to students were conversing

about the positives and negatives of graduate school; interacting with other graduate students in an informal and formal setting; and learning about their personality types during formal meeting activities. Students in the learning community appreciated the ability they had to share their struggles, accomplishments and questions about graduate school with each other (LC2, LC4, LC6). One student said the learning community offered necessary information and experiences that allowed for self-reflection, which helps him navigate through graduate school. He also said that the learning community was a way for students to integrate into graduate school (LC4). Another student said*, "Having the learning community is helpful because it gives you people that are going through the same fears/worries as me, which made it helpful to get through my first year"* (LC2). Another student added that it is *"…nice to hear people talk about and ask questions related to their grad school experience. I am not usually a person to ask questions, but it is also interesting and broadening to hear about what other people are dealing with in grad school"* (LC4). Another student said the learning community helped her survive her first year of graduate school. Part of that was knowing other students were going through the same thing she was. She also said the learning community was equipping her to complete graduate school as effectively and enjoyably as possible (LC6). LC7 stated, *"It's [the learning community] a good community of people bringing problems together in order to walk their way through a brand new process that everyone is a part of."*

One of the pieces learning community members appreciated most about the learning community was the social interaction between students. A student said the learning community helped her appreciate things about herself she thought were weird like the fact that she was loud, open and extroverted. The learning community helped her realize these parts of her personality she thought were weird benefited her in situations where she could lead others in the learning community (LC8). Another student said the learning community exercises helped her establish a relationship with her graduate advisor so she could get more "stuff" done in her lab. Once she connected with her advisor, she could progress in her research. The exercises that taught her how to communicate with her advisor were some of the most helpful things she experienced through the learning community (LC2). Another student said:

"Getting to hear the perspective of my fellow grad students in different departments allowed me to go back to my department and make sure that I was completing the things I needed to and ensuring that I am on track to graduate in a timely manner. Basically, I was able to go back to my advisor and ask questions that I might not had otherwise asked if it weren't mentioned in our learning community." (LC1)

Both LC1 and LC2 stated the learning community helped them progress in their graduate programs. LC2 further stated she appreciated *"getting to hear and learn about the other graduate students struggles and accomplishments"* (LC2). A third student said:

"I really liked the 2nd year mentoring activities, especially interacting with and getting to know my mentee. It was also nice to get to know the two cohorts from other departments. I also found the second year personal development activities that [leader] sent us to be useful, since they were things that I could directly apply to my career." (LC3)

Students appreciated the opportunities and activities they participated in during the time they were members in the learning community. A primary suggestion was the community become more structured and allow for more informal interactions among members to build a stronger sense of unity (LC4, LC6).

One student enjoyed the informal social interactions she experienced with the learning community at a restaurant that she was unable to have during the formal meetings (LC8). At the formal meeting, which occurred monthly, students learned more about themselves: their strengths and personality types (LC1, LC4). They also appreciated the life planning sessions as LC7 stated, *"For me, the most meaningful part of the learning community was the life-planning session. I constantly struggle with making decisions and that gave me a good lens to begin making big life choices."* LC7 also said the life-planning exercise was very helpful with helping him decide on a career path.

Least Meaningful Experiences

Participants of the learning community said there were several things that were least meaningful to their experience as part of the learning community (LC1, LC2, LC3, LC7 and LC8). LC1 stated, "*I guess if I had to pick something it would be the personality tests. Though meaningful it just reaffirmed things I knew about myself…"* This opinion was echoed by LC3 who said*, "Some of the activities during the first year were not very useful for me, such as the personality type tests, which I think most students have taken in the past and did not give me new information"* (LC3). Another student had different expectations for what the learning community would offer as he stated:

"Most of the stuff we discussed (in the meetings) was useful. However, whenever we had the faculty members come in to discuss expectations of a mentoring relationship with us I was a bit left out. This is mostly due to the fact that I am not a 'science-based' major and therefore have no labs. [Department] is just a different animal and so that specific session did not help me as much as it helped the other students." (LC7)

Similarly, LC8 had differing expectations for her experience in the learning community. She wanted to be able to confide in her peers in a more personal way and talk more openly about the issues she was having in graduate school. She said that she would feel judged at times if she was too open with her peers (LC8).

Suggestions for Learning Community Enhancement

Students in the learning community offered some helpful feedback regarding the structure and activities currently taking place as part of this program. Students addressed concerns of structure, more social interaction and discussion of struggles and accomplishments. The participants offered their perspectives on changes or recommendations they would make to the learning community that resulted in two primary themes: structure/content and social interaction.

Structure and Content

The structure of the formal meetings was something that several students addressed (LC4, LC6, LC7). Student LC7 offered a helpful suggestion for how the formal meetings could be structured when he said:

"Most of the material was helpful, but some of the timing of it could probably be rearranged. For instance, the first meeting could be discussing deadlines and expectations, the second meeting being establishing the life-plan to help us get on track early and the third meeting be the 'mentor expectations meeting,' as I believe that time around November/December is when most MS students really begin to work with their chairs." (LC7)

Another student, LC6, offered a suggestion for the instructors to incorporate into formal meetings. When referring to the learning community members, LC6 thought there was an inherent understanding that their graduate advisors will suggest where to present and be a part of conferences (professional development). She suggested [faculty] in the program should discuss more opportunities for LC members to professionally develop as graduate students. She said there is an assumption that the LC members are involved in professional development, when that is not always the case. She would have liked more guidance with the mentoring process and she said there should be more "loose accountability" for professional development and mentoring. There was no feedback loop to check on their progress throughout the semester/year. She wished the learning community members also had more interaction with the new cohort as a group (informal meeting). Lastly, she said there should be more interaction within structured activities (LC6).

Student LC4 built upon what LC6 and LC7 said when he stated, *"I feel like the second year could benefit from more structure, because the community portion from the first year seems to be lacking when we only meet sporadically. Being able to interact and learn from others in our same situations is a bit harder in this year"* (LC4).

The content of formal meetings was another topic that students discussed (LC1, LC4). LC1 stated, *"The cohort that I am apart of is tasked with finding a personal development activity to participate in. I think this should be encouraged more…Especially for things like technical writing and the submission process for graduate school."* In addition, LC4 offered the suggestion *"A meeting dedicated to learning how to write grants, make a better poster, design a better PowerPoint presentation, etc. would all be things that are topical and may give a graduate student a leg up both during their time here and after."*

Social Interaction

Another theme that emerged was social interaction among students. The students showed they desired more social interaction, especially in an informal manner (LC6, LC8). One student said she felt like more outside, social interaction would help facilitate a more personal touch to the group (LC8). The students discussed wanting more informal interactions to build a stronger sense of unity among learning community members (LC6, LC8). One informal interaction a student enjoyed was the ropes course activity where she could engage with the new group in a less formal environment (LC6). This same student stated she wanted more opportunities to just "dish" out with other students and discuss the difficult situations they were in so they could help each other navigate those issues. She wanted it to be a more open community. There was still a sense of "best-face-forward" in the learning community. She missed not meeting with the group as a whole (with both cohorts) (LC6).

Conclusions

The results of this study indicate the graduate learning community did allow students to have meaningful experiences, which helped them to integrate socially into their graduate program. Students reported social interactions were one of the most meaningful components of the learning community, but more social interaction was a recommendation for future learning communities. Being able to integrate academically and socially is key to graduate student success and influences the commitment students have on their personal goals during their time in graduate school (Tinto, 1993). Graduate students in this study did not specifically discuss how the learning community helped them integrate academically into their graduate program; therefore, future research is recommended to assess this aspect of graduate learning communities. Also, because this study examined graduate student perspectives after one year in the learning community, there was not yet data on the retention of these graduate students. Further research is needed to longitudinally examine how a graduate learning community affects the retention of graduate students due to the low attrition rates and low completion rates of graduate students (Bowen and Rudenstein, 1992; Golde, 2000; Smallwood, 2004; Sowell, 2008; Sowell et al., 2015).

The five core practices of the learning community model that Kraska (2008) outlined are the following: community, diversity, integration, active learning and reflective assessment. The learning community used in this study displayed these five core practices as displayed in the findings. Students experienced community during the regular, monthly meetings throughout the year. Diversity was an integral piece woven throughout

the learning community as most participants came from minority backgrounds. Integration occurred through the sharing of knowledge and academic conversations that participants had with each other and the administrators of the learning community. Participants engaged in active learning through the interactive assignments that helped them understand their personality types and personal strengths. Lastly, reflective assessment occurred during the meetings when students were encouraged to discuss their academic programs and the successes and challenges associated with them.

Graduate students described the most meaningful activities as those activities that provided social interaction among the members and discussed more social interaction as a recommendation for future students. Social interaction appears to be an important benefit of being in the graduate learning community. It is recommended that future learning communities implement more activities designed to facilitate social interactions among the learning community members. A recommendation for informal meetings would be to offer a semi-structured environment where the instructors would give the learning community a framework that incorporated conversation starters so the students would feel comfortable opening up and getting to know each other. One example would be speed conversations (like speed dating). In this activity, students would have the opportunity to share their research topic, how graduate school is going for them, what they are most looking forward to, what they are dreading, struggles, accomplishments, etc. Whatever activity or structure chosen, the goal should be building community through informal conversations among the members of the graduate learning community.

The findings from this study indicate students found the personality assessments to be meaningful activities and ones they appreciated. However, the results of this study also suggest some learning community members did not find the personality assessments beneficial because they were repetitive. Future graduate learning communities should examine how to best approach the implementation of a personality assessment. A needs assessment could be conducted to determine who has already completed the personality assessment prior to participating in the learning community so the learning community organizers can examine how to best approach the group.

Brower et al. (2007) posited that a sense of ownership over the community should be an outcome of a learning community. While it may appear that a loosely structured learning community allows students to take ownership of their group, the members of this learning community felt that structure was still needed to help them build community. Based on the recommendations discussed by the participants, learning community members would appreciate more structure within the formal meetings along with more accountability and follow-up to the activities they are required to complete. Learning community facilitators should implement more structure to aid in forming functional relationships and shared discovery and learning within the graduate learning community. Lastly, graduate students were not always aware of professional development opportunities such as professional meetings and conferences that they should attend. Learning community facilitators should gather more information about the graduate student's faculty mentor and assist when needed to recommend activities for participation.

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The Whole is Greater than the Sum: An Empirical Analysis of the Effect of Team Based Learning on Student Achievement[1]

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Abstract

We examine whether teams exert a positive influence on student test scores in three Team Based Learning (TBL) courses at two different universities. We find positive and significant effects on individual exam scores for students at all levels of the ability distribution; on average, an individual's exam score increases roughly six points for every 10-point increase in their teammates' average score. In addition, we find that these positive effects vary little across the ability distribution of teams and individuals, suggesting that the TBL method benefits a continuum of student abilities.

Keywords: Team Based Learning, peer effects, teaching methods

Introduction

"The strength of the team is each individual member…the strength of each member is the team." Phil Jackson.

Team Based Learning (TBL) is a student-centered teaching strategy that harnesses the power of peer learning by having students work in teams throughout the semester. TBL shifts instruction from a traditional lecture-based teaching paradigm to a structured learning sequence. The method includes three phases: 1) individual student preparation outside of class, 2) individual and team based multiple-choice tests based on the assigned reading or other class preparation and 3) active, in-class problem solving exercises completed in student learning teams. (A more detailed explanation of the TBL method can be found in Michaelsen et al. (2004) and Sibley and Ostafichuk (2014)). The amount of in-class time allotted to problem-solving allows the instructor to observe students' thinking, get instant feedback on how well students grasp the material and correct misunderstandings as they occur. In a TBL course, students are required to take on more personal responsibility for assimilating topical information and knowledge since there are fewer lectures. They spend more time applying or "doing" the subject matter in class. As described by Michaelsen et al. (2004), students are regularly required to solve complex problems and make decisions as a group, communicate clearly with one another and collaborate effectively with their peers. We believe these communication and team-work skills have lasting value post-college even if the specific knowledge or information from the course may lose relevance over time.

Case study research on the effectiveness of Team Based Learning reports positive impacts of the method on student outcomes, (Springer et al., 1999, Nokes-Malach et al., 2015). Several studies, particularly in the health professions, report better or equivalent learning outcomes and greater participation as compared with more traditional teaching formats (Hazel et al., 2013; Clark et al., 2008; Searle et al., 2003). In addition, many find improved student attitudes toward learning and working in teams (Espey, 2010). In our own experiences, students consistently report on course evaluations that working in teams makes the course more enjoyable and more effective. For example, one student commented: *"I enjoyed the collaborative work in teams. It is practical and helps prepare us for a real-world job. While it adds some stress to the class work, it is a fresh approach*

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to teaching. You can only learn so much from a slide deck and this class pushed students to work together and collaborate in order to be successful." Other students express frustration with their team experience in the course evaluations. The most common frustrations related to team members who don't do enough, or who do too much: *"Some of the students in our group didn't pull their weight."*

In general, we observe that more students report positive than negative experiences and outcomes from the TBL format on course evaluations. While the anecdotal evidence suggests that TBL can at least improve student attitudes without detracting from learning and, at best, improve student learning and make class more fun, there is to date little quantitative analysis on TBL effects on student performance. In this paper, we focus on measuring the effects of teams on student test scores in Team Based Learning classrooms. A few studies of medical and pharmacological students have reported significantly higher final exams scores in TBL courses relative to non-TBL formats (Persky, 2012; Koles et al., 2010; Thomas and Bowen, 2011; Kubitz, 2014). To our knowledge, this is the first study of the effect of teammate's performance on undergraduate student test scores in a TBL setting. Specifically, we want to assess whether and for whom teams have positive effects on individual performance and conversely, if and for whom, teams may produce negative (or worse than expected) outcomes. We evaluate the following claims regarding the effect of Team Based Learning on student outcomes: 1) teams exert a positive influence on individual performance, 2) the effects of teams vary by the ability of the team and 3) the effects of teams vary by the ability of the individual. We find a positive impact of teammates' performance on individual performance. In addition, we find that these positive effects vary little across the ability distribution of teams and individuals, suggesting that the TBL method is a robust teaching approach that benefits a continuum of student abilities.

Linking Peer Effects and Student Achievement

The empirical evidence of peer effects on academic performance at the college level is relatively limited (Sacerdote, 2011; Epple and Romano, 2011). Identifying peer effects is difficult because of issues of self-selection (students sort into particular schools or classes, for example) and "reflection," the idea that peer effects work in two directions: not only are a student's outcomes influenced by his peers, but he influences his peers' outcomes as well, particularly when they are together for some time (Manski, 1993). At the college level, it is also challenging to identify the relevant group of peers that may affect an individual's behavior.

"Roommate studies," which measure peer effects of randomly assigned college roommates on student academic performance are mixed in their findings, some finding small positive effects and others finding no evidence of peer effects (Sacerdote, 2001; Zimmerman, 2003). More recent research that better defines peer groups and includes better controls for individual ability before group formation is also mixed. In a study of freshman at the U.S. Air Force Academy, Carrell et al. (2009) find positive and significant peer effects by squadron, especially in math and science courses. In addition, they find weak evidence that the effects are larger (and positive) for students in the bottom third of the ability distribution. The implication, they suggest, is that placing low-ability students into peer groups with high ability peers can improve student performance.

Peer effects studies at primary and secondary school levels find wide ranging effects. However, Sacerdote (2011) notes two consistent themes in this literature. First, gender variation matters. Classrooms with higher percentages of females have higher test scores (Hoxby, 2000; Lavy and Schlosser, 2011). Second, peer effects are non-linear, although the evidence on the nature of the non-linearity is mixed. Some studies find that students at the lower end of the ability distribution benefit more from the presence of high ability peers than do students at the high end of this distribution, while others find that higher ability students experience the largest peer effects. For example, Burke and Sass (2013) report that students with low initial achievement levels appear to benefit less from an increase in the average ability of their peers than do students with higher initial scores. Lower ability students may even experience negative effects as the average ability of their peer group increases. Lavy et al. (2012) find that having a large fraction of low ability peers significantly and negatively affects the achievement of schoolmates, while average ability and the proportion of high ability peers does not seem to matter.

One implication of the above studies' findings is that team construction and composition matters. An important facet of the TBL method and a distinction from traditional group learning, is how teams are constructed. According to Michaelsen et al. (2004), three principles are paramount to team formation: 1) teams are selected by the instructor, 2) the instructor should devise a strategy to create diversity in the teams and 3) the selection process should be transparent to the students. Teams are formed by the instructor to "distribute class resources," deliberately mixing students of varied ability together in teams to roughly balance the expected performance of each team in the class. To implement this, the instructor considers the characteristics or skills believed to determine success in the course (e.g., writing skills, math skills, attitude and experience with course-related material) and constructs teams to diversify groups along these criterion. Students remain in their teams for the entire semester.

Data and Methods

To evaluate the effect of teams on individual performance, we use individual student data collected in three different economics courses – Intermediate Microeconomics, Cooperatives and Agribusiness Finance – across two universities. All are taught from econom-

ics or agricultural economics departments and primarily service undergraduates pursuing economics or agricultural business degrees.

These courses utilize the essential elements of TBL and, importantly, followed the prescribed TBL team construction methods. Following Michaelsen et al. (2004), teams in this study were deliberately formed to mix students of varied ability and backgrounds together in teams to roughly balance the expected performance of each team in the class. For example, in the intermediate microeconomics course, students were allocated to teams based on their reported grade point average (GPA), major and gender. The objective was to roughly equalize the average grade point average across teams, while ensuring a mix of majors and gender on each team. Teams were formed in a similar fashion in the other two courses. In all courses, instructors used administrative data from course enrollment files for student rank (i.e., freshman, sophomore, junior, senior), gender and major. Students' GPAs were self-reported on a beginning-of-the-semester student information sheet in which they were asked, "What is your cumulative GPA at <institution>?"

The TBL method of team formation differs in notable ways from other studies that examine team and peer effects. First, our peer groups are small relative to studies of peer effects at the classroom or cohort level, consisting of between four and eight students per team. Second, the length of interaction as a team is shorter in our data, one semester as opposed to a year or more in the studies cited above. In a large peer group of classmates, students may not have frequent, direct interaction with their higher- or lower-ability peers. A central tenant of TBL is that team members work and interact closely with team peers in almost every class period, which is the case with the teams in our study. We know the peer groups in our courses interact because we require them to do so in class. Finally, teams are formed by the instructor, but not randomly assigned.

Our empirical strategy is to use a student random effects framework to detect the effects of teammates' test performance on individual test scores, controlling for individual ability (GPA), other personal characteristics (e.g., major, gender) and course-specific variables. Our measures of student achievement are test scores in the courses. In each course, multiple end-of-unit exams are given during the semester. The repeated observations on each student allows us to employ panel estimation techniques and control for unobserved individual attributes. We estimate the following student random effects regression using data from the three courses:

$$S_{ijk}=\alpha_i+\delta_1 P_{j-i,k}+\delta_h P_k^h x\ P_{j-i,k}+\delta_l P_k^l x\ P_{j-i,k}+\beta\ '\ X_i+\varepsilon_{ijk} \quad (1)$$

where *i* denotes students, *j* denotes teams and *k* denotes the exam. $P_{j-i,k}$ is the average score on test *k* of team *j* excluding individual *i*. Its coefficient, δ_1 measures the impact of teammates' exam performance on the student's individual score, controlling for individual attributes and ability; this is our primary measure of the team effect. The student characteristics vector, X_i, includes student's overall GPA, gender and a dummy variable equal to 1 if the student is an Economics or Agricultural Business major and 0 otherwise. Students with majors in economics or agricultural business may have a different motivation for taking the course and thus different incentives to perform than outside majors. However, it is unclear whether majors will perform better or worse. Students may perceive the class to be closely related to their field and work to perform better, or they may be uninterested in the course but required to take it to meet their graduation requirements.

To investigate whether the team effects vary across the distribution of team performance, we create two dummy variables. The first, P_k^l, takes a value of 1 if team *k*'s average score on the exam was in the bottom quartile of the class distribution and zero otherwise. Similarly, P_k^h, takes a value of 1 if team *k*'s average score on the exam was in the top quartile of the class distribution and zero otherwise. These dummy variables are interacted with $P_{j-i,k}$ to investigate if peer effects in the bottom and top quartiles of the class distribution differ significantly from the average effect. We constructed comparable dummy variables, P_i^l and P_i^h by the distribution of individuals' GPA and interacted them with $P_{j-i,k}$ to examine the third claim that peer effects vary by the ability of individuals.

According to Sacerdote (2011) there are two main approaches to measuring and identifying peer effects. First is exogenous variation in the assignment of peer groups. While the TBL instruction strategy relies on a non-random assignment of students to teams, students are assigned to teams exogenously, by the instructor rather than through self-selection. Second, student fixed effects are often included to control for self-selection into classrooms. We also exploit this strategy by using panel data estimation techniques to account for the repeated observations on individual students and including dummy variables for courses. While we cannot separate the peer effects that result from peers' background (what Manski (1993) terms exogeneous effects) from those that result from peers' current outcomes (Manski (1993) calls these endogenous effects), we can analyze the existence, direction and magnitude of any existing peer effects. Regardless of the precise channel through which peer effects operate, having a better understanding of the relationship between an individual's performance and the performance of a small group of peers with whom they work closely over the course of a semester does provide useful information about whether and how, the TBL teaching method affects student outcomes.

Results and Discussion

Table 1 provides descriptive statistics by course. The number of students in the courses ranged from 42 in Agribusiness Finance to 75 in Cooperatives. Two exams were given in the Cooperatives and Agribusiness Finance courses, while a total of six tests were given in Intermediate Microeconomics. Note that the individual average scores for all three courses are roughly equal.

The microeconomics course has a somewhat larger variance in demonstrated performance by students and their teams. The student-reported overall GPAs indicate a student average of approximately 3.0 on a 4.0 scale in all three courses. The proportion of majors (economics and agricultural business) to non-majors is approximately equal in Intermediate Microeconomics and Cooperatives, but 88% of the students in the Agribusiness Finance class are majors. The proportion of women in the courses ranges from a high of 45% in Cooperatives course to a low of 28% in Intermediate Microeconomics.

Table 2 presents descriptive statistics on the teams. Our main criteria for sorting students into teams is GPA. The fact that teams are constructed to be balanced is evident in the lack of variation in average GPA across teams and a simple regression of GPA on team dummy variables by course showed no significant differences in average GPA across teams. We also strive to include a mix of gender and majors on each team, however; these are somewhat less evenly balanced across teams. Nevertheless, the key idea is that teams begin on an "even playing field" at the beginning of the semester in terms of observable attributes.

Table 3 presents the main results of the random effects regressions. We estimate four versions of equation (1). Model (1) includes only the team effect, while Model (2) adds individual attributes. Model (3) adds the interaction terms to assess whether team effects vary at the upper and lower end of the team distribution; Model (4) includes the comparable measures for the individual distributions. We conduct the estimation for all three courses combined including course fixed effects to control for any observed differences across courses and instructors that may affect exam performance.

The first claim implied by the TBL strategy is that teams exert a positive influence on individual performance. This is corroborated in our data. The average team effect, $P_{j-i,k}$, is significant and positive in Model 1. In Model 2, controlling for individual characteristics, the average team effect is 0.62. The interpretation is that a student's own test score increases 0.62 points for every 1-point increase in his or her teammate's average score. This is not a trivial effect. For example, a one standard deviation increase in teammate's average score would raise an individual's score roughly four or five points – at least a letter grade, using a standard grading scale

Table 1. Descriptive Statistics by Course

	Intermediate Microeconomics		Cooperatives		Agribusiness Finance	
	Mean (std. dev.)	Min/Max	Mean (std. dev.)	Min/Max	Mean (std. dev.)	Min/Max
$IndivScore_i$	72.93 (13.15)	25.5 / 104	73.11 (11.37)	44.4 / 108	73.98 (12.30)	42 / 98
$TeamAve_{j-i}$	72.81 (8.17)	54.75 / 89.25	73.11 (5.91)	60.15 / 83.29	73.98 (4.71)	66.29 / 81.21
GPA	3.06 (0.58)	1.60 / 3.90	2.97 (0.58)	1.53 / 4.00	3.17 (0.43)	2.13 / 3.91
AgBus/Econmajor	0.58 (0.49)	0 / 1	0.49 (0.50)	0 / 1	0.88 (0.32)	0 / 1
Male	0.72 (0.45)	0 / 1	0.55 (0.50)	0 / 1	0.62 (0.49)	0 / 1
Number of students	43		75		42	
Number of exams	6		2		2	
Max number of observations	258		150		84	

Table 2. Descriptive Statistics by Team

	Intermediate Microeconomics				Cooperatives				Agribusiness Finance			
Team	Mean (std. dev.) GPA	Min/ Max	% Male	% Major	Mean (std. dev.) GPA	Min/ Max	% Male	% Major	Mean (std. dev.) GPA	Min/ Max	% Male	% Major
1	3.072 (0.55)	2.33 3.83	100	80	2.821 (0.71)	1.53 4.00	57	43	3.05 (0.50)	2.13 3.60	71	100
2	3.000 (0.62)	2.21 3.90	75	0	3.02 (0.57)	2.23 4.00	63	63	3.03 (0.49)	2.24 3.61	63	75
3	2.936 (0.57)	2.18 3.75	80	40	2.848 (0.41)	2.17 3.30	57	57	3.158 (0.44)	2.61 3.77	57	86
4	2.948 (0.58)	2.30 3.80	60	40	2.98 (0.61)	1.70 3.67	43	57	3.25 (0.41)	2.73 3.88	57	86
5	3.017 (1.03)	1.60 3.80	75	25	3.073 (0.56)	2.10 3.60	63	25	3.29 (0.43)	2.74 3.91	57	86
6	3.223 (0.39)	2.80 3.71	75	100	2.78 (0.61)	1.95 3.47	71	71	3.21 (0.27)	2.94 3.54	67	100
7	3.210 (0.50)	2.84 3.90	75	50	3.01 (0.56)	2.20 3.61	38	36				
8	3.09 (0.60)	2.30 3.67	50	100	3.01 (0.60)	2.00 3.90	25	36				
9	3.263 (0.28)	2.90 3.54	50	75	3.124 (0.45)	2.50 3.65	57	43				
10	3.00 (0.48)	2.31 3.44	75	75	3.056 (0.66)	1.63 3.84	75	13				
Course Mean	3.06 (0.58)	1.60 3.90	72	58	2.97 (0.58)	1.53 4.00	55	49	3.17 (0.43)	2.13 3.91	88	62

Table 3. Results: Effect of Teammates' Performance on Student Achievement (S_{ijk}), All Courses Combined[a]

	Actual Teams			
	(1)	(2)	(3)	(4)
	0.584***	0.620***	0.383***	0.599***
	(10.74)	(12.84)	(4.36)	(11.99)
			-0.065***	
			(4.55)	
			0.039***	
			(2.69)	
				0.009
				(0.27)
				0.067**
				(2.00)
GPA_i		13.58***	12.97***	11.42***
		(10.56)	(11.01)	(3.84)
$AgBus/Econmajor_i$		-1.11	-0.86	-0.31
		(0.78)	(0.62)	(0.24)
$Male_i$		0.71	0.89	1.16
		(0.59)	(0.75)	(0.95)
constant	30.379***	-13.25***	5.86	-7.39
	(7.28)	(2.77)	(0.92)	(0.75)
N	489	423	423	423
R-sq	0.0649	0.4048	0.4491	0.4241
F-test of joint significance				
Low quartile			0.001	0.000
High quartile			0.000	0.000

[a]Includes course dummy variables with Intermediate Microeconomics serving as the base. These dummy variables are insignificant in all 4 models.

Notes: Asterisks denote significance: *p<.05; **p<.01; ***p<.001

with +'s and –'s. This estimate should be considered an upper bound of the teammate's effect given the potential reflection and non-random assignment issues in our empirical design.

The sign and significance of the team effect is robust to the addition of individual characteristics, indicating the student random effects effectively controls for unobserved student-specific attributes. Not surprisingly, grade point average (GPA) is strongly positively correlated with individual test scores, but gender and major do not seem to matter.

The second claim we evaluate is that team effects vary by the 'ability' of the team. Despite instructor efforts to distribute individual student resources roughly equally among teams, team performance does inevitably vary and sometimes a great deal. In fact, the range in team averages on the exams in our data is as high as 27 points. To the extent that any measured peer effects also vary with overall team performance, instructors may look for better ways to construct the teams in their courses to mitigate some of this variation. On the other hand, if there is no apparent difference in the size of the team effect between high- and low-performing teams, it would suggest that the current methods are acceptable and that they are not giving an unfair advantage or disadvantage to certain teams.

Model (3) examines whether the team effect varies for high- and low-performing teams. The results in Table 3 for Model 3 suggest there is little difference in the magnitude of the team effect for teams at the top quartile or the bottom quartile of the distribution relative to teams in the middle of the distribution. The coefficient for low quartile teams (P_k^l=1), is negative and significant, but it is quantitatively very small, reducing the team effect by six-hundredths of a point from 0.38 to 0.32. The coefficient for top quartile teams, (P_k^h=1) is positive and significant, but again, very small, increasing the team effect from 0.38 to 0.42. The bottom row of the table reports the p-values for an F-test of joint significance for the interaction terms and $P_{j\neq i,k}$, verifying that the effect is positive and significant across the distribution of team performance. Figure 1 shows the average estimated effects along with the 95% confidence interval. These vary little across the three groups. Perhaps the comfort from this finding is that there appears to be only minor ramifications of team qualifications and performance vis-à-vis the "messiness" of resource distribution in team formation. A possible implication is that there are potential across-the-board gains to activities directed at "team building" and efforts or incentives to stimulate team activities and performance. Importantly, the peer effect remains positive and strongly significant at all levels of the team distribution.

The final claim we analyze in this paper is that peer effects vary by the ability of the individual. Some instructors believe that TBL helps higher ability students more than lower ability students. With TBL, students do teach each other. To the extent that the best way to learn something is to teach it, much of the benefit of TBL may accrue to the higher ability students who often assume the teaching role. Others believe that TBL may have greater effects on lower ability students in that it encourages them to be more engaged and ask more questions, particularly of their peers. Results here indicate that both these instructor intuitions may have merit. The results for Model (4) suggest that peer effects do not vary much by individual student ability as measured by GPA. The effect is significantly larger for students in the top quartile of the ability distribution, raising the estimated effect of teammate's performance from 0.60 to 0.67. However, there is no significant difference between students at the low end of the ability distribution and those in the middle.

Figure 2 plots the average effect and 95% confidence interval across ability groups. Similar to Figure 1, the overlapping confidence intervals suggest little difference across the groups, although the estimated effect of teammates' performance is larger for higher ability students. A potential concern is that GPA is a questionable indicator of "ability" for team formation purposes. Alternatively, a lack of difference in the team effects

Figure 1. Estimated Effect of Teammate's Performance on Individual Performance, by Team Performance

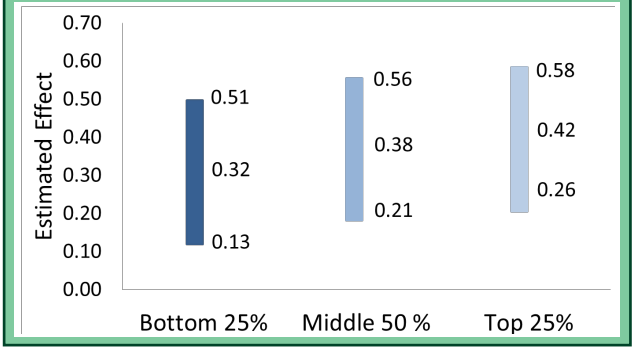
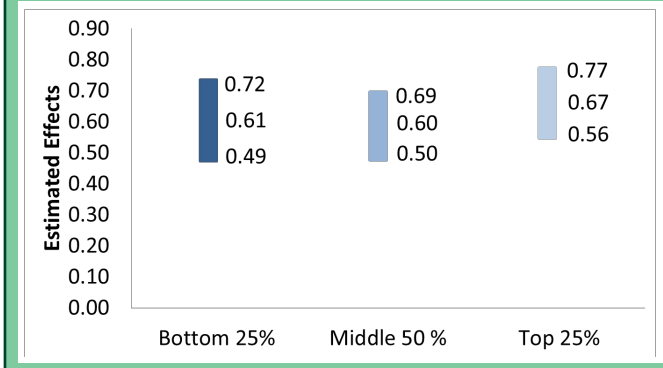


Figure 2. Estimated Effect of Teammate's Performance on Individual Performance, by Individual Performance



Note: Graphs show the point estimate and 95% confidence interval for the peer effect by quartile.

for high and low GPA students could indicate the TBL approach benefits different students via different mechanisms or pathways as per the commonly perceived benefits of TBL. If GPA is a reasonable indicator of ability, then the implication is that TBL is a very robust teaching approach that benefits a continuum of student abilities.

Summary

For instructors considering significant pedagogical changes in the classroom, a common concern is the uncertain benefit of contemplated changes relative to the time and energy necessary to make the changes. Furthermore, there is always the concept of "unintended consequences" in that a new method may help certain types of students but potentially make other types worse off. This paper addresses these issues and concerns with respect to Team Based Learning.

The TBL technique engages students in a course, allowing them to discover the material largely through group exploration and exercises and by building cohesive team units. TBL continues to gain popularity and there are several reasons to suspect that it has positive effects on students' enjoyment of the class and the development of the "soft skills" that are necessary beyond the classroom. To date, however, there is little empirical evidence to judge whether TBL does influence student performance in the course. For an instructor considering switching to TBL, confidence that team activities help the individual students is perhaps a primary motivation to make the switch. This team effect on individual performance was the focus of our investigation.

We conducted an empirical test of the effectiveness of Team Based Learning on student performance using student characteristics and performance from three undergraduate courses. We find evidence of significant positive effects of a team's exam performance on individual test scores. On average, the effects are meaningfully large: a 10-point increase in teammates' average test score may raise a student's exam score by 3 to 6 points. In addition, we find that while the estimated peer effect is positive and significant on average for students at all ability levels, there is little evidence that these effects are different for students in the top or bottom quartile of the grade point average distribution. This combination of findings implies that TBL is a very robust approach for helping the entire spectrum of student abilities in the classroom. Finally, there is evidence that team ability has only a small effect on individual performance: higher performing teams marginally improve the performance of its members by more than low performing teams. From an instructor's perspective, this finding implies there is some leeway in the process of allocating resources in team formation.

This research improves our understanding of the benefits of Team Based Learning and other collaborative learning and teaching methods, provides insight into how to form more effective teams in our classrooms and will likely generate ideas among those who have used and want to implement TBL into their classroom. It suggests that in addition to previous research findings demonstrating that TBL enhances student enjoyment and engagement in the course, there are positive effects on student learning as measured by exams. Many practical questions remain that this analysis is unable to address, such as: what is the mechanism that generates the variation in peer effects, are there other student characteristics that matter for determining TBL effectiveness, is there a "best" way to assign and structure teams and what does that depend on and how can instructors further enhance the peer effects for lower ability students? Future exploration into these questions may help those instructors using or planning to implement TBL in their classrooms design more effective and engaging learning environments for their students.

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Current and Anticipated Funding Sources and Expenses for Four-Year Collegiate Livestock Judging Programs[1]

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Abstract

Collegiate livestock judging programs require financial resources to support expenditures associated with competition and overall team achievements. Recent economic pressures have forced administrators to critically evaluate program the value of co-curricular programs. Therefore, the purpose of this research was to examine the current and anticipated sources of support and expenditures associated with university livestock judging programs. Each of the thirty-nine four-year college livestock judging programs that competed at the North American International Livestock Exposition in 2012, 2013, or both years, were sent a researcher-developed electronic survey. Twenty-nine surveys were returned for a 74.4% response rate. Most collegiate livestock judging programs received funding from their academic unit(s), stakeholders, development accounts and via fundraising revenue. Less than half of collegiate livestock judging teams received funding support from student participants, in-kind support, or other sources. Most respondents anticipated level funding support from the academic unit(s) over the next few years. However, among those who expected a change in academic unit(s) support, ten anticipated a decrease and only one anticipated an increase. Over half of the respondents anticipated expenditures for travel, contest entry fees and overall livestock judging program expenditures to increase over the next five years.

Introduction

Intercollegiate livestock judging is a co-curricular activity that provides opportunities for students to apply animal science knowledge related to livestock selection, production and management. Laboratory exercises involving livestock judging *". . . quickly became the focus of interest for students, because it prepared them for the rapidly expanding purebred segment of the livestock industry . . ."* during the late 1890s and early 1900s (Willham, 2008, p. 9). Taylor and Kauffman (1983) reported that for the first 50 years (beginning in the late 1800s through the mid-1900s), livestock judging was one of the primary subjects of animal science instruction taught to students. Visual appraisal was the primary means of assessing the value and quality of livestock during that time period. Despite a few complaints in the 1930s, the importance of livestock judging was not seriously challenged until the 1960s. Subsequent changes in required coursework resulted in livestock judging classes becoming elective courses in many animal science programs by the 1980s (Taylor and Kauffman, 1983).

Literature associated with the cost of sponsoring collegiate judging teams was limited to one survey conducted in the late 1990s that encompassed all non-salary expenses of animal related judging teams (livestock, meats, dairy, horse, wool and meat animal evaluation teams). Expenditures for judging programs ranged from $2,500 to $25,000 annually, with an average annual expense of $10,953.70. Academic institutions covered 50% of the costs on average, along with funding provided by team members (15.2%), endowments (12.2%) and annual giving (11.2%) covering the remaining costs (Field et al., 1998). According to McCann and McCann (1992), the financial cost of sponsoring an intercollegiate livestock judging team coupled with the de-emphasis of livestock judging as a subject, contributed to a reduction in the number of collegiate livestock judging programs in the U.S. For example, the number of collegiate livestock judging teams declined from 44 in 1981 to 31 in 2013

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(108th National Collegiate Livestock Judging Contest Awards Breakfast Program, 2013).

Much like contemporary collegiate athletic programs, colleges of agriculture in the late 1800s and early 1900s recognized the need to recruit students to their institutions and capitalized on their livestock judging team as one avenue for recruitment (Willham, 2008). Some colleges with agricultural programs still support a livestock judging team to promote student interest in their agriculture departments. Illinois Central College, Peoria, IL, recently established a livestock judging program specifically for this purpose and reported over 100 students enrolled in their agriculture department for the first time ever during the 2013-2014 academic year (G. Grebner, personal communication, September 9, 2013). The program manager in charge of recruiting students to the College of Food, Agricultural and Environmental Sciences, at The Ohio State University, reported an increase in student interest in attending the institution as a result the school's competitive success at recent livestock judging competitions (J. Tyson, personal communication, April 12, 2014).

Sources of funding support for higher education have changed dramatically in recent years. State appropriations for higher education dropped from $9.74 per $1,000 in personal income in 1989-1990 to $5.63 per $1,000 in personal income in 2011-2012 (Baum and Ma, 2012). College students are responsible for over half of the actual cost of their education today, compared to only 38% in 1998 (Desrochers et al., 2010). Research funding support has coincidently shifted more to private sector sources and individual contributions (Baum and Ma, 2012). Funding resources for educational programming and co-curricular activities are also likely to experience a similar trend shifting away from public sources of support.

Based upon somewhat analogous evidence which implies that athletic success can lead to increased student interest in academic institutions (Toma and Cross, 1998), a similar phenomenon may exist within agriculture departments in relation to livestock judging programs (G. Grebner, personal communication, September 9, 2013; Willham, 2008).

Financial support systems for higher education has shifted and will likely continue to shift away from public funding toward cost recovery in the form of student tuition (Baum and Ma, 2012; Desrochers et al., 2010). Research and program funding within higher education has also begun to be outsourced to private partners and individual contributors (Baum and Ma, 2012; Desrochers et al., 2010). Based upon these resource shifts, financial support for collegiate livestock judging programs may also become increasingly dependent upon external stakeholder contributions.

Purpose

This study was conducted to identify and describe support, expenditures, anticipated trends in support and expenditures, anticipated trends of espoused stakeholder support and their relationship to competitive performance and the structure and characteristics of senior college livestock judging programs. The following research objectives were developed to guide this study.

1. Describe the sources and amounts of funding support for university livestock judging programs.
2. Describe the expense categories and amounts included in university livestock judging program budgets.
3. Describe anticipated trends of funding support for university livestock judging programs.
4. Describe anticipated trends of expense categories and amounts for university livestock judging programs.

Materials and Methods

Livestock judging programs in four-year colleges and universities in the United States that competed in the North American International Livestock Exposition (NAILE) in 2012, 2013, or both years, comprised the target population for this study (N=39). Contest results from the NAILE in 2012 and 2013 contests were used to identify institutions included in the target population. The population frame included the livestock judging program in each respective institution. Subjects were identified by the president of the National Collegiate Livestock Coaches' Association. Two subjects were replaced with alternate contacts from their respective institution, due to personnel changes and the survey was conducted based upon the final population frame (N=39).

Data collection was conducted according to the tailored design method (Dillman et al., 2008). Pre-notification letters were sent via email on October 27, 2014, to 39 subjects inviting their participation in the study, informing them of materials needed to complete the electronic questionnaire and that they would be receiving a URL link to the survey. A cover letter containing the URL link to the data collection instrument was sent via SurveyMonkey®, (a secure online survey administration service) on November 3, 2014. The initial cover letter included a description of the research and the human subjects review requirements. Subjects were asked to click on or copy and paste the secure URL link into their Internet browser to complete the data collection instrument within three weeks. On November 10, 2014, the cover letter was resent as a first follow-up email message through SurveyMonkey® to subjects that had not yet responded. A third, identical follow-up email message was sent via SurveyMonkey® on November 17, 2014, to subjects who had not yet responded. A fourth cover letter email was sent via SurveyMonkey® on November 21, 2014, to subjects that had still not responded. The data collection process was closed on December 8, 2014.

Two subjects reported they did not receive the data collection instrument due to SurveyMonkey® site restrictions and were sent electronic cover letters and web links using the researcher's University email account. The locally established site restrictions were

beyond the researcher's control. A similar timeline for sending reminder emails was used for the two subjects receiving individual electronic cover letters and URL links.

Data analysis began on December 10, 2014. Thirty-one subjects provided data out of 39 subjects in the target population, yielding an initial response rate of 79% (n=31). Two of the 31 responses were partially complete and were excluded from the data set yielding a 74.4% response rate based on 27 useable responses. Greater than 10% of the information requested on the data collection instrument was missing from the two excluded responses.

Cronbach's alpha reliability coefficient for internal consistency was computed post-hoc using data collected in this study to assess reliability of the data collection instrument (n=29). The post-hoc test revealed a Cronbach's alpha reliability coefficient of 0.850 based upon variables comprising anticipated trends of funding support and expenditures and 0.885 for variables comprising current and anticipated trends in espoused stakeholder support. Each reliability coefficient was higher than the minimum threshold alpha level of 0.70, which was established a priori to determine reliability. Therefore, the data collection instrument used in this study was considered reliable (Nunnally and Bernstein, 1994).

Ten randomly selected support variables were used to compare early to late respondents (Lindner et al., 2001). Respondents were divided into quartiles based upon when each completed survey was electronically submitted. Early respondents were defined as those responding within the first quartile (n=7). Late respondents were those responding during the fourth quartile (n=7). Independent t-tests revealed no significant differences when comparing the means of the early and late respondents based on ten randomly selected topics involving anticipated trends in support or expenditures associated with four-year university livestock judging programs.

Results and Discussion

The primary sources of funding support for collegiate livestock judging teams were academic unit(s), stakeholders, development accounts and annual fundraising (Table 1). Two funding ranges from $10,000 to $24,999 and $25,000 to $49,999 were the most commonly selected categories of funding from academic units for livestock judging programs with six (21.4% each) respondents selecting each category. Fifteen (53.6%) subjects reported receiving financial support within the $1 to $4,999 range from stakeholder donations.

Students, in-kind giving and all other sources did not provide support for the annual livestock judging program budget at over half of the institutions that participated in this study. Sixteen (59.3%) respondents indicated that their livestock judging program did not receive financial support from student participants. The most common response category to describe the level of in-kind support for collegiate livestock judging programs was $0, which was selected by 17 (63.0%) respondents (n=27). Eighteen (75.0%) survey responses selected the $0 option, three (12.5%) respondents selected the $5,000 to $9,999 range, two (8.3%) selected the $1 to $4,999 range and one (4.2%) reported receiving funding in the $10,000 to $24,999 range for all other sources of financial support.

Salary and travel composed the greatest amount of total dollar expenditures at most institutions (Table 2). Eighteen (62.1%) subjects reported salary expenditures (apportioned specifically for livestock judging program coaching activities) in categories exceeding $10,000. Likewise, travel expenditures were reported to exceed $10,000 by 20 respondents (71.4%). Contrarily, scholarship expenditures were reported to be $0 by 16 respondents (59.3%).

Although most respondents (62.1%; Table 3) indicated funding support from academic unit(s) is not likely to change, of those that anticipated change, ten respondents (34.5%) anticipated a decrease over the next five years compared to only one (3.4%) that anticipated an increase. Most respondents also expected expenditures for travel (58.6%; Table 4) and contest entry fees (55.2%) to increase over the same time period. Subsequently,

Table 1. Sources of Funding Support Received During Fiscal Year 2013-2014 for Livestock Judging Programs at Four-Year Colleges and Universities.

	Frequency (Percentage)[a]						
Funding Support Source	$0	$1 to $4,999	$5,000 to $9,999	$10,000 to $24,999	$25,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999
Academic unit(s) (n=28)	3 (10.7)	5 (17.9)	2 (7.1)	6 (21.4)	6 (21.4)	4 (14.3)	2 (7.1)
Stakeholder donations (n=28)	7 (25.0)	15 (53.6)	2 (7.1)	2 (7.1)	2 (7.1)	0 (.00)	0 (.00)
Development accounts (n=29)	8 (27.6)	8 (27.6)	2 (6.9)	6 (20.7)	5 (17.2)	0 (.00)	0 (.00)
Student participants (n=27)	16 (59.3)	7 (25.9)	1 (3.7)	2 (7.4)	1 (3.7)	0 (.00)	0 (.00)
Fundraising revenue (n=28)	7 (25.0)	10 (35.7)	4 (14.3)	4 (14.3)	3 (10.7)	0 (.00)	0 (.00)
In-kind support (n=27)	17 (63.0)	9 (33.3)	0 (.00)	1 (3.7)	0 (.00)	0 (.00)	0 (.00)
All other sources (n=24)	18 (75.0)	2 (8.3)	3 (12.5)	1 (4.2)	0 (.00)	0 (.00)	0 (.00)

[a]No subjects reported receiving over $100,000 from any of the funding sources.

Table 2. Financial Expenditures in Support of Collegiate Livestock Judging Programs at Four-Year Colleges and Universities during Fiscal Year 2013-2014.

	Frequency (Percentage)[a]					
Type of Expenditure	$0	$1 to $4,999	$5,000 to $9,999	$10,000 to $24,999	$25,000 to $49,999	$50,000 to $74,999
Salary (n=29)	6 (20.7)	4 (13.8)	1 (3.4)	9 (31.0)	8 (27.6)	1 (3.4)
Employee benefits (n=28)	14 (50.0)	8 (28.6)	4 (14.3)	2 (7.1)	0 (.00)	0 (.00)
Travel (n=28)	0 (.00)	2 (7.1)	2 (7.1)	10 (35.7)	8 (28.6)	0 (.00)
Contest entry fees (n=28)	1 (3.6)	26 (92.9)	1 (3.6)	0 (.00)	0 (.00)	0 (.00)
Scholarships (n=27)	16 (59.3)	5 (18.5)	2 (7.4)	4 (14.8)	0 (.00)	0 (.00)
Team awards (n=27)	13 (48.1)	14 (51.9)	0 (.00)	0 (.00)	0 (.00)	0 (.00)
Instructional resources (n=28)	12 (42.9)	16 (57.1)	0 (.00)	0 (.00)	0 (.00)	0 (.00)
All other types of financial expenditures (n=25)	16 (64.0)	7 (28.0)	3 (8.0)	0 (.00)	0 (.00)	0 (.00)

[a]No subjects reported financial expenditures above $75,000 for any expenditure category.

overall expenditures were expected to increase by most respondents (55.2%).

Financial data were collected within ranges to encourage participation in the reporting process, which inhibited precise budget determination. However, some benchmarks were defined for discussion purposes. Three hypothetical budget amounts were computed by summing the low end of the lowest category selected by at least one respondent to reflect the lowest level of funding provided by each source for the livestock judging program. A second hypothetical budget was computed by summing the top end of the range of the highest category selected by at least one respondent. A third hypothetical budget was determined by summing the midpoint of the range of the modal category (i.e. most frequently selected) by respondents. Using this process, the lowest possible budget was $0, the highest possible budget was $349,993 and the modal category midpoint summation was $32,000. Hypothetical financial expenditures were also computed using a similar procedure, which yielded hypothesized annual expenditures of $1, $40,000 and $249,993 for low end, modal midpoint and high end expenditure budgets, respectively.

Most respondents anticipated funding from academic units to either stay the same or decline over the next five years, which could result in a funding shortfall for programs that rely heavily on departmental support. This scenario is somewhat analogous to a business in a capitalist economy. Businesses that generate higher rates of return on investment are more likely to attract additional funding to grow and expand. Conversely, less profitable businesses often face challenges associated with declining resources, meeting cash flow obligations and may eventually face bankruptcy and/or cease to exist. Therefore, competitive livestock judging teams are more likely to attract external funding and thrive as a result of their competitive success, while underfunded and less competitive teams may cease to exist due to the eventual effects of funding limitations.

Table 3. Anticipated Changes in Financial Support for Collegiate Livestock Judging Programs at Four-Year Colleges and Universities Over the Next Five Years (n=29).

	Frequency (Percentage)		
Source of Funding Support	Decrease	Stay the Same	Increase
Academic unit(s)	10 (34.5)	18 (62.1)	1 (3.4)
Stakeholder donations	2 (6.9)	16 (55.2)	11 (37.9)
Development accounts	1 (3.4)	14 (48.3)	14 (48.3)
Student participants	1 (3.4)	21 (72.4)	7 (24.1)
Fundraising revenue	1 (3.4)	12 (41.4)	16 (55.2)
In-kind support	0 (0.0)	21 (72.4)	8 (27.6)
Overall financial support	2 (6.9)	12 (41.4)	15 (51.7)

Table 4. Anticipated Changes in Financial Expenditures for Collegiate Livestock Judging Programs at Four-Year Colleges and Universities Over the Next Five Years (n=29).

	Frequency (Percentage)		
Source of Financial Expenditure	Decrease	Stay the Same	Increase
Salary	3 (10.3)	18 (62.1)	8 (27.6)
Employee benefits	4 (13.8)	22 (75.9)	3 (10.3)
Travel	3 (10.3)	9 (31.0)	17 (58.6)
Contest entry fees	1 (3.4)	12 (41.4)	16 (55.2)
Scholarships	0 (0.0)	23 (79.3)	6 (20.7)
Team awards	2 (6.9)	19 (65.5)	8 (27.6)
Instructional resources	1 (3.4)	21 (72.4)	7 (24.1)
Overall financial expenditures	1 (3.4)	12 (41.4)	16 (55.2)

Field et al. (1998) reported (from a national survey) that non-salary expenditures for all judging programs (livestock, meats, dairy, horse, wool and meat animal evaluation teams) were paid by academic institutions (50%), team members (15.2%), development accounts (12.2%) and annual stakeholder giving (11.2%). Field et al. (1998) also noted that livestock judging team members contributed the second highest amount of funding support for livestock judging program activities in the late 1990s. However, this study revealed that team members at most institutions did not provide funding support for the annual livestock judging program budget. Coincidently, fundraising activities were not mentioned in previous literature, but were identified as a major source of funding support in this study. In addition, most respondents expect annual fundraising to increase over the next five years and fundraising was at least moderately important to most of the coaches and their supervisors. Therefore, it appears that the expectation of students to directly contribute funding support for the livestock judging team budget may have been supplanted with an expectation of team members to service fundraising activities. Many institutions host youth livestock judging camps that are frequently staffed by team members during the summer months, which may provide funding support for the livestock judging program budget (2014 Judging Camps, 2014).

Increased fundraising activities could also be in response to the expected changes in funding support from academic unit(s) that were revealed in this study. Most respondents expect funding support from academic unit(s) to either stay the same or decrease over the next five years. Independently, either of these scenarios would result in a net decrease of funding available to support judging programs if overall expenditures increase, which was the expectation shared by most of the respondents in this study. Travel expenditures were a cost that most respondents anticipated to increase in the future. Hotel accommodations, food, transportation and other costs associated with travel will likely continue to increase because of economic inflation. Contest entry fees were also anticipated to increase by most respondents, which could be the result of higher fees charged at individual contests or larger expenditures if teams decided to participate in more contests on an annual basis.

Therefore, coaches might value fundraising as a means to achieve their competitive goals, whereas supervisors might view extramural funding support as one method of decreasing the financial burden that McCann and McCann (1992) partially attributed to the decline in the number of livestock judging programs across the country. Anticipated reductions in funding support provided by academic units for collegiate livestock judging teams may be counteracted with increased fundraising activities, which would simultaneously enable coaches to direct funding toward areas viewed as more important for their specific team goals and contribute to long term

program sustainability. Regardless of the identified need for fundraising, the wide disparity in funding that likely exists across livestock judging programs suggests that some institutions may benefit from increased extramural funding resources.

Summary

Previous research involving collegiate judging programs focused primarily on student development outcomes or funding. The research problem for this study was to determine how collegiate livestock judging programs have been supported in the past and to identify trends that will likely impact future financial support and expenditures. Funding for livestock judging programs in the future will likely shift from academic unit support to extramural sources, e.g. fundraising and donations. Although some academic unit funding is expected to continue, the proportion of academic unit support in the total budget is expected to decline over time. Extramural funding appears to be directly linked to competitive performance. Thus, livestock judging team coaches may need to become more entrepreneurial in conducting fundraising activities to build or maintain sustainable programs.

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Incorporating Writing-Intensive Assignments in an Animal Science Production Course

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Abstract

In-class writing assignments were administered to an upper level animal science production class to enhance students' exposure to writing and to facilitate learning and application of course material. Results from pre- and post-survey assessments indicated that these writing assignments gave students more confidence in writing, as they were less nervous about the writing process at the end of the semester ($P<0.05$), had greater confidence in constructing graded compositions ($P<0.05$) and had an improvement in overall self-perceived writing ability ($P<0.05$). Students indicated the writing assignments helped them learn to better express ideas through writing ($P<0.05$) and that they had a better feeling about handing in well-done compositions at the end of the semester ($P<0.05$). Students acknowledged that writing allowed them to more thoroughly think through concepts ($P=0.06$). More than half (58%) indicated that the writing assignments assisted in a more thorough understanding of course material and 65% reported the writing assignments were relevant and useful toward overall learning in class. The in-class writing assignments served as a successful mechanism for improving course content comprehension, as well as increasing students' exposure and confidence with writing.

Introduction

Among employers, communication skills rank among the most highly sought-after aptitudes (Crawford et al., 2011; Hart Research Associates, 2010) and recruiters have identified students' writing abilities as an important consideration in the hiring process (Leggette et al., 2011). In a survey of employers to determine skills necessary for student success in a global economy, 89% indicated that colleges should place more emphasis on effective oral and written communication and 81% believed that a focus on improving critical thinking and analytical reasoning skills was necessary (Hart Research Associates, 2010). Previous studies have found that writing facilitates critical thinking (Condon and Kelly-Riley, 2004; Hanstedt, 2012; Hobson and Schafermeyer, 2004). Despite the recognized need for improved writing skills among college graduates, recent research suggests that they are not meeting employer expectations in competencies for written and oral communication (Fischer, 2014).

Facilitating activities that enhance writing exposure in the classroom can help students improve writing skills and comprehension of course content (Aaron, 1996; Barry and Orth, 2013). Teaching students to write effectively is a process, requiring constant reinforcement and practice (Barry and Orth, 2013; Hanstedt, 2012); thus, students need increased exposure to writing outside of formal English courses. As with the mastery of any skill, repeated, purposeful practice is fundamental to improve writing aptitude (Johnstone et al., 2002; Kellogg and Raulerson, 2007) and writing-intensive courses facilitate this practice. Moreover, scholars have advocated for the integration of writing skills into the agricultural curriculum (Leggette et al., 2011). Leggette (2015) noted that instructors can make changes to their classes to integrate writing and improve students' writing skills. One suggestion was to provide students with feedback on their writing performance several times during the class. This is something students also desire in writing-intensive classes and is pivotal in helping improve students' writing competency (Kellogg and Raulerson, 2007; Leggette and Homeyer, 2015; Pajares and Johnson, 1994).

Faculty understand the benefits of facilitating writing in courses, but many are reluctant to incorporate into classes because of the increased work-load that coincides with providing meaningful and timely feedback. Also, if the writing assignment is given in class, professors may not be able to justify lecture time for the activity. However, Kellogg and Raulerson (2007) encouraged instructors to view writing as a mechanism for facilitating learning and related the writing process to activating knowledge. Scholars have emphasized that effective writing activities do not need to be extensive papers and

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Table 1. Selected Examples of Writing Prompts and Expected Outcome of Written Response in an Animal Science Production Course at Texas Tech University

Prompt	*Expected outcome*
Why did the 2011 Beef Quality Audit indicate that information sharing among segments of the beef industry is one of the largest issues facing the industry? What are two or three ways you would propose enhance this capability in the industry?	Demonstrate understanding of beef industry segmentation, use of facts to synthesize solutions.
What is the significance of "stepping-up" cattle to feed? Discuss specific methods of how cattle may be "stepped-up" to feed and factors that influence the variation and duration of this management practice.	Evidence of a basic understanding of transition diets and in-field application of process. Overall, responses should biological facts and management implications of the practice
What is implant payout? Discuss time of re-implantation relative to implant payout and explain potential impacts of re-implanting on cattle performance and carcass quality. Also, briefly describe how marketing strategies can influence an implant program.	Generalized understanding of the biology of implants, management of implants and synthesis of how/why implants impact cattle marketing.
What is the most important cause of morbidity and mortality in feedlots? In your discussion, be sure to include information regarding factors that contribute to the onset of the disease, the impacts of the disease on animal performance, and ways to manage the disease. When discussing ways to manage the disease, be sure to define metaphylactic treatment and when this type of treatment would be warranted.	Responses should synthesize factors that contribute to the onset and management of Bovine Respiratory Disease and demonstrate a basic understanding of these factors.
Beta-adrenergic agonists are a class of growth promoting agents approved for use in feedlot cattle. Currently the feeding of beta-agonists has drawn controversy and opposing views from within the industry, resulting in the removal of one of the products (zilpaterol-hydrochloride, Zilmax) from the market. You were assigned to preview material which presented contrasting viewpoints regarding beta-agonist usage. For your writing discussion, indicate why there is concern for beta-agonist administration, discuss the nature of the research that has been conducted since the removal of Zilmax, and be sure to indicate pertinent findings from current beta agonist research (including both viewpoints) For your summary statement, based on the data available, indicate what you think the industry should do regarding the feeding of beta-agonists regarding Zilmax feeding in the future and why you feel your response is sound advice.	The material the students were asked to review presented divergent viewpoints from beef industry leaders regarding the use of beta-agonists. Responses should demonstrate a basic understanding of beta-agonist usage, reasons of concern with usage, and the ability to draw conclusions from evaluating scientific data.

reports, rather, comprehension of course content and critical thinking can be evaluated and facilitated through short writing activities (Barry and Orth, 2013; Hobson and Schafermeyer, 2004). Innovative alternatives to traditional writing assignments include short writings and prompted in-class discussions based-on in-class writings, which increase writing exposure, provide students time to think about course concepts and do not substantially increase instructor workload (Butler et al., 2001; Drabick et al., 2007; Stewart et al., 2010).

Beyond what instructors in writing-intensive classes choose to do to encourage students' writing, another factor may be at play. Many students are anxious about the writing process and may even dread completing writing activities. Daly and Miller (1975) defined this fear or anxiety of writing as writing apprehension. Individuals with high levels of writing apprehension avoid writing whenever possible and when forced to write, they are anxious and expect to do poorly. Those who have low levels of writing apprehension enjoy the writing process and seek out opportunities to write. Writing apprehension can impact students' ability to perform writing tasks in the classroom and has even been found to influence college major choices (Daly and Shamo, 1979).

Overall, effective writing skills are important to enhance students' ability to communicate well, think through concepts and are highly valuable across all disciplines. These skills are becoming increasingly important for students within the agriculture field to master, not only for personal success in the industry, but also to communicate to a growing consumer population that is far removed from production agriculture (Aaron, 1996). Thus, it is important that instructors in agriculture fields emphasize effective communication, particularly through writing, both for student success and for the betterment of the industry. However, instructors must also realize that some students may have underlying apprehension regarding the writing process that may inhibit their writing performance.

In an effort to facilitate writing exposure, improve students' writing ability in an agriculture discipline and enhance critical thinking skills, upper-level undergraduate animal science production classes at Texas Tech University are required to be writing-intensive. To fulfill this requirement and to stimulate in-class learning and critical thinking about lecture material, weekly writing assignments were incorporated into a stocker and feedlot cattle management course, which is an upper-level production course, cross-listed for undergraduate and graduate students. The purpose of this study was to: 1) describe undergraduate and graduate students' writing apprehension scores at the beginning and end of the course and 2) assess students' perceptions of the effectiveness of in-class writing assignments in helping them better understand and apply course material.

Methods

Weekly in-class writing assignments were integrated into a dual-listed, writing-intensive stocker cattle and feedyard management course. Courses designated as writing intensive at the university have a requirement that students "write often." This course had previously been designated as writing intensive and this assignment was designed as one element to help fulfill the writing intensive requirement. The writing assignments described in this paper were based on prompts related to the week's lecture material, represented 25% of the student's final grade and were assessed using a rubric for individualized feedback. Each assignment was evaluated to gauge the student's comprehension of lecture material, ability to synthesize information and competence to apply lecture topics to real-world application. Several writing prompt examples and a summary of expected outcomes for each are presented in Table 1. Procedures conducted

in this study were deemed exempt by the Texas Tech University Institutional Review Board.

Class lectures were Monday, Wednesday and Friday. Writing prompts were administered at the beginning of Friday lecture and students were allowed approximately 25 minutes to complete the in-class assignment. Students were notified of writing assignments the Monday prior to administration. To encourage students to keep current with lecture material and review notes, students were not allowed to use notes or supplemental material during the writing activity. Writing assignments were not administered every week due to scheduling conflicts with guest speakers, field trips and exams.

Writing assignments were evaluated and returned to the student prior to the subsequent assignment. A standardized writing rubric adapted from Fort Hays State University Department of Political Science (n.d.) was used to assess following criteria: 1) overall organization of the paper; 2) logic and analysis (to assess critical thinking ability); 3) use of evidence (accuracy of students' ability to apply class material to prompt response); 4) mechanics. Each criterion was evaluated on a 0-4 scale and students were provided with feedback and suggestions for improvement. For reference, a link to this rubric is provided in the Fort Hays State University citation.

To assess students' attitudes toward writing, a modified version of the Daly-Miller Writing Apprehension Test (WAT) (Daly and Miller, 1975) was administered at the beginning and end of the semester. The instrument was adapted to include 20 items instead of the original 26 (Richmond et al., 2013). An instrument was also completed at the end of the semester for student feedback directly related to the structure of the in-class writing assignment. Responses for both instruments were based on a 5-point Likert scale with 1 = strongly disagree and 5 = strongly agree. There were 36 undergraduate and 10 graduate students enrolled in the course, with 27 and seven, respectively, completing all assessments. To calculate the WAT scores, the following formula was used: WAT = 48 –Total of scores for negatively worded statements + Total of scores from positively worded statements (Richmond et al., 2013). Based on this formula, the possible range of WAT scores can be from 20 to 100. According to Richmond et al. (2013) scores from 45 to 75 are in the normal range of apprehension; scores below 45 indicate a low level of apprehension and scores above 75 indicate a high level of apprehension toward writing. Pre- and post-test mean scores for questions on the WAT were compared using a paired samples t-test in SAS statistical software (SAS Inst., Inc., Cary, NC) with differences in means declared significant when $P<0.05$. Whereas student perceptions of the writing assignment are presented as frequency means.

Results and Discussion

The calculation of overall WAT scores indicated that all students fell within the "normal" range for writing apprehension (Richmond et al., 2013). At the pre-test, scores ranged from 50 to 68 while the post-test scores ranged from 46 to 68. Eighteen students had a decrease in their WAT scores, one stayed the same and 15 had an increase.

Examination of the individual items for the WAT are presented in Tables 2 and 3 for undergraduate and graduate students, respectively. A comparison of pre- and post-test WAT scores revealed that at the end of the course compared with the beginning, undergraduate students were more comfortable with their writing assignments being evaluated, felt they were better able to express ideas through writing, had an easier time beginning a composition, felt less nervous about writing and developed a greater confidence in writing (Table 2; $P<0.05$). Writing is a skill that requires deliberate practice (Kellog and Raulerson, 2007; Hanstedt 2012). The development of competency is related to one's comfort level of that skill. Pajares and Johnson (1994) indicated that student's beliefs about their writing capabilities were significantly related to their writing aptitude in that students who were more confident in their writing skills had higher scores on the writing assignment measured in this study.

As Leggette (2015) suggested, instructors can make changes to improve students' writing skills. The findings of the current study suggest that short, in-class writing assignments were sufficient for increased writing exposure and provided writing practice, which helped students feel more comfortable with writing and improved their perceptions toward writing. In general, there was a positive improvement in student's scores on the in-class writing assignments throughout the semester as well (data not shown). Students were more cognizant of

Table 2. Mean responses of pre- and post- Daly-Miller Writing Apprehension Test for undergraduate students (n=27)

Question[x]	Pre	Post	Significance level[y,z]
I avoid writing	3.19	2.96	NS
I have no fear of my writing's being evaluated	2.78	3.22	NS
I am afraid of writing essays when I know they will be evaluated	3.00	2.63	**
I can better express my ideas through writing	2.85	3.22	**
Handing in a composition makes me feel good	2.52	3.07	*
My mind seems to go blank when I start to work on my composition	3.07	2.56	**
Expressing ideas through writing seems to be a waste of time	2.42	2.26	NS
I like to write down my ideas	3.11	3.26	NS
I feel confident in my ability to express my ideas clearly in writing	2.81	3.30	**
I like to have my friends read what I have written	2.30	2.56	**
I'm nervous about writing	3.19	2.70	**
People seem to enjoy what I write	2.85	3.26	**
I enjoy writing	2.59	3.07	**
Writing allows me to get my thoughts together	2.81	3.52	**
Writing helps me think more critically about concepts	2.92	3.42	NS
I have a terrible time organizing my ideas in a composition course	3.08	2.63	NS
Writing allows me to more completely think through concepts	2.88	3.37	*
I don't think I write as well as most other people	3.35	3.16	NS
I don't like my compositions to be evaluated	3.19	2.89	NS
I'm not good at writing	3.15	2.58	**

[x]Responses based on 5-point Likert scale where 1 = *strongly disagree* and 5 = *strongly agree*

[y]Significance level of change between post and pre-evaluation

[z]NS = non-significant; ** $P \leq 0.05$; * $P \leq 0.10$

writing and those who were struggling with the assignments frequently visited the instructor for tips on writing instruction. The increased writing confidence among undergraduate students observed in this study could have been the result of students' developing a better understanding of the writing assignment throughout the semester, repeated writing practice, feedback incorporation or a combination of these factors.

Although not analyzed, there was a greater magnitude of change brought about by the writing assignments for undergraduate students (n=27) compared with graduate students (n=7), which may be due to the smaller number of responses for graduate students versus undergraduate students. The differences may also be related to a greater overall writing exposure for graduate students, because of the increased writing demands of graduate work. The lack of change in pre- and post-responses among graduate students suggests they were overall more comfortable with the writing process and that the increased writing exposure did not improve or degrade their writing confidence (Table 3).

Table 3. Mean responses of pre- and post- Daly-Miller Writing Apprehension Test for graduate students (n=7)

Question[x]	Pre	Post	Significance level[y,z]
I avoid writing	2.00	2.28	NS
I have no fear of my writing's being evaluated	3.57	3.43	NS
I am afraid of writing essays when I know they will be evaluated	2.14	2.29	NS
I can better express my ideas through writing	3.14	3.29	NS
Handing in a composition makes me feel good	3.29	3.43	*
My mind seems to go blank when I start to work on my composition	2.43	2.29	NS
Expressing ideas through writing seems to be a waste of time	2.14	2.00	NS
I like to write down my ideas	4.00	3.43	NS
I feel confident in my ability to express my ideas clearly in writing	3.71	3.71	NS
I like to have my friends read what I have written	3.29	3.43	NS
I'm nervous about writing	2.14	2.14	NS
People seem to enjoy what I write	3.29	3.57	NS
I enjoy writing	3.43	3.43	NS
Writing allows me to get my thoughts together	3.43	2.86	NS
Writing helps me think more critically about concepts	4.00	4.00	NS
I have a terrible time organizing my ideas in a composition course	2.43	2.14	NS
Writing allows me to more completely think through concepts	3.57	3.86	NS
I don't think I write as well as most other people	2.57	3.14	NS
I don't like my compositions to be evaluated	2.29	2.71	NS
I'm not good at writing	2.29	2.14	NS

[x]Responses based on 5-point Likert scale where 1 = strongly disagree and 5 = strongly agree

[y]Significance level of change between post and pre-evaluation

[z]NS = non-significant; * P ≤ 0.10

To gather additional feedback regarding the use of brief, in-class writing assignments, students completed an additional researcher-developed instrument at the end of the semester. Undergraduate students indicated an improvement in their ability to use writing to more completely think through concepts (pre-test *M*=2.88, post-test *M*=3.37; *P*<0.05, Table 2). Undergraduate students did not show a change in their thoughts regarding the use of writing to more critically think about concepts at the end of the semester (*P*>0.10, Table 2), but did not disagree with this statement (*M*=3.17; Table 2), whereas graduate students agreed with the statement at both assessment times (pre- and post-test *M*=4.0; Table 3). In addition, undergraduate students reported an improvement in their perceptions of using writing to put their thoughts together (*P*<0.10; Table 2) at the end of the semester.

Presumably, with the increased writing expectations for graduate students, they are more accustomed than undergraduate students to the practice of writing to assimilate facts to answer an applied question. Though critical thinking was not measured directly in this study, writing provides the opportunity for critical thinking through the process of logically assimilating thoughts and ideas, which activates higher-level thinking (Condon and Kelly-Riley, 2004; Hobson and Schafermeyer, 2004). Thinking is not an outward process, making assessment of critical thinking difficult; however, Hanstedt (2012) reported that writing is a mechanism for gauging critical thinking skills. Because of the identified need to improve analytical and reasoning skills among college graduates, development of short writing-based activities that lend themselves to critical thinking should be investigated further.

Using a standardized rubric and hand-written comments, instructors provided timely feedback to students to facilitate the writing process and to help them identify knowledge gaps within course material. For all the students surveyed in this study, 60.5% (Table 4) indicated that the feedback they received for the in-class writing assignments was enough for them to make changes in their writing approach (Table 4). Furthermore, one of the reasons behind the implementation of this in-class writing activity was to serve as a mechanism for stimulating class discussion. After each writing activity, time was dedicated to discussing the prompt and encouraging students to share their responses. Through this activity, 51.2% (Table 4) of students indicated that they felt more comfortable discussing course material after completing the writing assignment. Overall, students seemed to have a positive perception of the in-class writing assignments to facilitate learning as 58% (Table 4) indicated that the in-class writing assignments helped them to more thoroughly understand course material and 65% (Table 4) noted the in-class writing assignments were relevant and useful for learning. In activities designed similarly to that described in this paper, others have reported positive student feedback and improved active learning through short, in-class assignments (Butler et al., 2001; Drabick et al., 2007; Stewart et al., 2010).

Although short writing activities expose students to writing and assist students with course content comprehension, instructors may still feel that any activity involving writing is related to an increased workload. Hobson and Schafermeyer (1994) suggested that instructors could reduce the grading burden by using self or peer-evaluation, or by using "formative" evaluation to rank papers as "low" "medium" or "high", without assigning a formal letter grade. Barry and Orth (2013)

Table 4. Mean percentage scores for students' perceptions of in-class writing assignments (N=43)

Question[x]	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	f	%	f	%	f	%	f	%	f	%
The in-class writing assignments helped me in more thoroughly understanding course material	1	2.3	8	18.6	9	20.9	22	51.6	3	6.9
The in-class writing assignments allowed me to feel more comfortable in discussing course material	2	4.6	6	13.9	11	25.6	22	51.2	2	4.6
The in-class writing assignments helped me to study for exams	1	2.3	10	23.3	15	34.9	15	34.9	2	4.6
I enjoyed the in-class writing assignments	6	13.9	9	20.9	15	34.9	13	30.2	0	0.0
The in-class writing assignments helped me learn to organize my thoughts when writing	1	2.3	7	16.3	11	25.6	21	48.8	3	7.0
I thought the in-class writing assignments were a waste of time	6	13.9	22	51.2	10	23.3	2	4.6	3	7.0
Feedback for in-class writing assignments was sufficient enough for me to be able to make changes in my approach to writing	1	2.3	2	4.6	12	27.9	26	60.5	2	4.6
The in-class writing assignments helped me to better understand components of effective writing	2	4.6	9	20.9	15	34.9	14	32.6	3	6.9
The in-class writing assignments enabled me to become more confident in my writing ability	6	13.9	4	9.3	14	32.6	16	37.2	3	6.9
The in-class writing assignments were relevant and useful toward my learning in this class	1	2.3	2	4.6	12	27.9	23	53.5	5	11.6

[x]f = frequency of response; % = frequency of the response divided by the total number of student responses for each question

mentioned incorporating guided peer-review for assignments requiring multiple drafts. Through this approach, student-reviewers are provided a list of questions to provide direction in focusing on key points and components of the paper. The application of these methods for writing review and revision are dependent on the nature of the course and writing activity; however, these and similar ideas merit consideration for instructors wishing to facilitate writing in courses.

Summary

Short, in-class writing assignments, administered periodically throughout the semester in an upper-level, animal science production course, were effective in fulfilling course writing-intensive requirements and were beneficial for increasing students' writing exposure and comprehension of course content. Students gained confidence with the writing process and were more willing to discuss course material after completing a writing assignment as they felt more comfortable with their understanding of course content following the writing activity. Drawbacks of this assignment are increased instructor workload through reading and evaluation; however, non-traditional approaches to grading writing, such as peer-evaluation, may be applicable to in-class writing assignments. Based on positive student feedback through this assessment, as well as comments to the instructor on course evaluation forms, this activity has continued to be administered in this class.

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Investigating Factors that Influence Achievement Goal Orientation and Educational Practices in Undergraduate Agricultural Sciences and Natural Resource Students

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Abstract

Goal orientation can aid in explaining/predicting behavior in academic settings. This inquiry examined undergraduate agricultural sciences and natural resource students' reasons for engaging in academic tasks at a land-grant university and determined the influence of academic efficacy, academic self-handicapping and skepticism about the relevance of school for future success on achievement goal orientation (mastery-approach, mastery-avoidance, performance-approach and performance-avoidance). Students possessed multiple reasons for engaging in academic tasks and as a result, we recommend instructors utilize immediate and long-term motivations during the teaching and learning process. Future research should investigate best practice on how to teach students with multiple goal orientations. In addition, a multivariate Tobit regression was used and parameter estimates were significant for academic efficacy and self-handicapping. Instructors should be cognizant of this and provide high-quality academic feedback to support academic efficacy, achievement motivation and skill acquisition and to reduce self-handicapping behaviors. Skepticism about the relevance of school for future success was not a significant predictor of achievement goal orientation and may not be an area of concern for instructors at the University of Tennessee. Future research should seek to determine other factors that influence achievement goal orientations and investigate educational practices that help students develop mastery goals for learning.

Introduction

Actions college and university instructors take to improve teaching and learning have an impact on the nation's future and play a critical role in preparing students as science professionals and well informed citizens (Kober, 2014). With that in mind, the subjects of teaching and learning are complex and effective teaching and learning has benefits for all students (National Research Council, 2009). According to Schunk (2012), learning is *"an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience"* (p. 3). When learning occurs, synaptic connections are formed and strengthened (Schunk, 2012). Researchers have purported learner, teacher and environmental variables influence teaching and learning (Bandura, 1986; Bransford et al., 2000; Dunkin and Biddle, 1974; Schunk, 2012). Similarly, the National Research Council (2009) reported a one size fits all approach to instruction would not help students with different learning styles and ways of assimilating information be successful in the classroom. Thus, educators can have an impact on a student's subject matter comprehension and motivation by understanding how their students learn (Schunk, 2012).

One aspect of the teaching and learning process is learner motivation (Bransford et al., 2000; National Research Council, 2009; Schunk, 2012). Learner motivation is a cognitive process whereby goal-directed activities are instigated and sustained (Schunk, 2008). According to Mankin et al. (2004), motivation is fundamental to learning and learner motivation has continuously been an issue for educators, since students have diverse backgrounds, different learning styles, interests and experiences. McCombs (as cited in Mankin et al., 2004) argued motivation to learn comes from external supports as well as internal processes. Therefore, teacher and student characteristics interact to create an environment that promotes or hinders motivation for learning (Mankin

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et al., 2004). Motivation for learning helps explain what a student learns, how a student learns and why students behave as they do (Schunk, 2012).

One aspect of agricultural sciences and natural resource education is to understand why students engage in academic tasks and what factors influence academic motivation. Understanding this key component may help improve teaching and learning in colleges of agriculture. This is important because colleges of agriculture are tasked with educating future leaders within the realm of agricultural science and natural resources and their graduates are essential in addressing the *"United States priorities of food security, sustainable energy and environmental quality"* (Goecker et al., 2014, Graduates section, para. 2). Furthermore, the United States depends on agriculture and agri-businesses as drivers in economic development in rural and metropolitan communities, which influences the long-term viability of local communities (National Research Council, 2009). What is more, employment opportunities in agriculture-related fields are increasing and the current supply of postsecondary graduates is only able to fill 61% of 57,900 annual employment openings. Complicating the issues is many agricultural graduates find opportunities for employment outside the agriculture sector – leaving an even larger gap between graduates with expertise in the agricultural sciences and employment demands (Goecker et al., 2014).

Based on the role motivation plays in learning and the need to produce postsecondary graduates with expertise in agriculture, this study will examine undergraduate agricultural sciences and natural resource students' reasons for engaging in academic tasks and factors that influence their academic motivation at the University of Tennessee. This information can be used to improve the teaching and learning experiences of agricultural sciences and natural resource students.

Theoretical Framework/Review of Literature

The theoretical framework for this study was goal theory, which was developed by educational and developmental psychologists to explain and predict the achievement behaviors of students (Schunk, 2012). *"Goal theory postulates that important relationships exist among goals, expectations, attributions, conceptions of ability, motivation orientations, social and self-comparisons, and achievement behaviors"* (Schunk, 2012, p. 374). Fundamental to goal theory is how different types of goals influence behavior and these types are known as goal orientations (Schunk, 2012). Goal orientation denotes the *"purpose and focus of an individual's engagement in achievement activities"* (Schunk, 2012, p. 374). Furthermore, achievement goal orientations are known to influence self-regulatory efforts related to learning (Ormrod, 2012; Schunk, 2012; Zimmerman and Cleary, 2009).

For this study, four types of achievement goal orientations were considered: *"mastery-approach (focused on attaining task-based or intrapersonal competence), performance-approach (focused on attaining normative competence), mastery-avoidance (focused on avoiding task-based or intrapersonal incompetence) and performance-avoidance (focused on avoiding normative incompetence)"* (Elliot and Murayama, 2008, p. 614). These orientations provide information on intrinsic motivation and performance attainment (Elliot and Murayama, 2008). Additionally, achievement goal orientations may not be mutually exclusive and students could possess them simultaneously (Daniels et al., 2008; Hidi and Harackiewicz, 2000; Ormrod, 2012).

Mastery Goals

Mastery goals can be described as developing ability, understanding the material, learning and improving skills (Ciani et al., 2010). Mastery goals can have two orientations: (a) mastery-approach and (b) mastery-avoidance (Senko et al., 2013). Mastery-approach and -avoidance goals arise when students perceive the class as engaging and interesting (Elliot and McGregor, 2001). Goal theory suggests mastery-approach goals are most adaptive and should be equal to or greater than that of the achievements and benefits from both performance goals (Senko et al., 2013). Belenky and Nokes-Malach (2012) posited mastery-approach goals may aid transfer by enabling cognitive processes that connect learning experiences. Mastery-avoidance goals have more negative antecedent than mastery-approach (Elliot and McGregor, 2001). Early research suggests mastery-avoidance has a negative effect on emotional factors related to learning (Schunk, 2012). Though, research on the effects of the two orientations considered separately is limited (Ormrod, 2012).

On the other hand, a more developed body of research suggests mastery goals are preferred to performance goals (Ormrod, 2012) and lead to positive effects on learning (Schunk, 2012). To that end, numerous outcomes are derived from mastery goals: (a) motivation, (b) persistence, (c) interest, (d) study strategies and (e) seeking out help (Ciani et al., 2010). Similarly, Ames and Archer (1988) and Nolen (1988, 1996) found mastery goals influence students use of effective learning strategies and deep process strategies that improve understanding. Senko and Miles (2008) suggested mastery goals promote high achievement and students with mastery oriented goals are the students who study material at a great depth, go above and beyond what the teacher is expecting as well as explore topics that are related to the course. Empirical evidence suggests mastery goal orientation promotes a motivational pattern that is likely to promote long-term and high-quality involvement in learning (Ames, 1992).

Performance Goals

According to Senko and Miles (2008), performance approach goals are unrelated to the benefits of mastery goals; those being high course interest and deep learning strategies. Performance goals define success

as outperforming peers with normative standards (Senko et al., 2013). With performance-approach goals, students focus on outperforming their peers and with performance-avoidance goals, students are trying to avoid poor performance compared to their peers. Senko et al. (2013) posited performance-approach goals aid achievement more for challenging rather than simple tasks. Performance goals can be negatively affected if the goals set are unreachable due to an obstacle and less than adequate performance to overcome that obstacle (Stout and Dasgupta, 2013). Additionally, performance goals can help mastery oriented students remain on task and perform well (Harackiewicz et al., 1997). *"The strength of aroused motivation to achieve as manifested in performance has been viewed as a function of both the strength of motive and the expectancy of goal-attainment aroused by situation cues"* (Atkinson, 1957, p. 359). Luo et al. (2011) stated under some circumstances performance goals are appropriate and can lead to high achievement.

Performance-approach and -avoidance goals are so closely related they may be activated simultaneously in the classroom (Law et al., 2012). This suggests a student could potentially have performance-approach goals as well as performance-avoidance at the same time in the classroom setting (Law et al., 2012). Elliot and Church (1997) found performance-avoidance was associated with fear of failure and low competence expectancies, whereas performance-approach was associated with achievement motivation, fear of failure and high competence expectancies.

Academic Self-Efficacy

How a student views their ability to complete a skill or task is known as their self-efficacy (Pintrich and Zusho, 2007). Pintrich and Zusho (2007) stated college students who have higher self-efficacy are more likely to be metacognitive; they will try to regulate their learning by controlling their cognition as the learning occurs. Furthermore, self-efficacy beliefs are positively related to adaptive and self-regulatory strategy use as well as to actual achievement in the college classroom (Pintrich and Zusho, 2007). Likewise, Pintrich (1999) purported students who believed they could learn were confident in their skills and more likely to report the use of self-regulatory strategies. Students can use self-efficacy as a personal resource when performing tasks associated with academic and self-regulated learning (Pintrich, 1999). Students' choice of activities can be influenced by self-efficacy (Bandura, 1977; Schunk, 2012).

Students with low self-efficacy for learning may avoid attempting tasks; those who judge themselves efficacious should participate more eagerly. Self-efficacy also can affect effort expenditures, persistence and learning. Students who felt efficacious about learning generally expend greater effort and persist longer than students who doubt their capabilities, especially when they encounter difficulties (Schunk, 2012, p. 147).

To that end, possessing the required knowledge and skills to perform a behavior may not be enough for students (Artino, 2012). According to Artino (2012), self-efficacy may be the motivating factor in academic choices rather than their competence. Similarly, Bandura (1977) posited self-efficacy can direct choice of activities and settings and influence coping efforts during a task through expectation of success. Thus, when self-efficacy is strong, coping efforts will be used more effectively (Bandura, 1977). Additionally, academic self-efficacy has been shown to positively influence socio-cognitive processes and is a robust predictor of academic performance in undergraduate students (Putwain et al, 2013).

Self-Handicapping

Self-handicapping is any action or choice of performance setting that enhances the opportunity to externalize failure and internalize success (Berglas and Jones, 1978). Examples of self-handicapping are procrastination (Pintrich and Zusho, 2007), not getting enough sleep or being unprepared for an examination, exaggerating the effects of illness or injury, as well as embracing impediments and plausible performance handicaps (Berglas and Jones, 1978). Berglas and Jones stated *"any use of self-handicapping that involves more than cognitive distortion presumably decreases the chances for success"* (p. 406).

Generally, self-handicappers are not looking to fail but are willing to accept failure if failing can be explained in an effort to preserve their self-esteem or conception of ability (Berglas and Jones, 1978; McCrea, 2008). Self-handicapping can lead to not achieving fully academically and prompt frustration among parents and teachers (Urdan, 2004). Gadbois and Sturgeon (2011) suggested poor prior performance would relate to future propensities to self-handicap within the student's future academic performance. When students fail, the obstacle at hand gives them the opportunity to transfer credit of the failure from their ability to the handicap (Schwinger et al., 2014). Self-handicappers also tend to display an uncertainty of their competence (Zuckerman and Tsai, 2005).

"Both denial and disengagement imply a tendency to turn away from a difficult reality in order to sustain an illusion of something better. Turning away from a difficult reality and constructing a situation more supportive of one's self-concept are core elements in self-handicapping strategies" (Zuckerman and Tsai, 2005, pp.414-415).

In contrast*, "people who know they have the talent and resources to master life's challenges are not likely to hide behind that attributional shield of self-handicapping"* (Berglas and Jones, 1978, p. 406). The behavior of self-handicapping occurs more frequently when value or importance increases (McCrea, 2008). Some disadvantages of self-handicapping are burnout (Akin, 2012) and lower health and well-being, competence satisfaction and intrinsic motivation (Zuckerman and Tsai, 2005). More specifically to teaching and learning, hand-

icapping behaviors are purported to inhibit deep and successful learning (Schwinger et al., 2014). Academic self-handicapping strategies have been associated with classroom goals, self-perception and learning strategies (Gadbois and Sturgeon, 2011). Gadbois and Sturgeon (2011) found academic self-handicapping had a negative relationship with self-regulated learning strategies, deep learning, intrinsic value of learning, self-concept clarity and academic self-efficacy.

Relevance of School

Perception of a task or activity can influence a student's approach to learning and can have consequences in their use of time to complete a task or activity (Ames, 1992; Good, 1983). Pintrich and Zusho (2007) stated learners have perceptions of the value and interest the task or content area has for them. *"Perceptions of the college classroom norms and classroom climate are important aspects of college students' knowledge activation of contextual information"* (Pintrich and Zusho, 2007, p.762) and perception of learning may be the catalysts for future learning (Picciano, 2002). The importance of the task and the task's value is related to the perception of the individual performing the task and the task's importance to the individual (Pintrich and Zusho, 2007). Pintrich and Zusho (2007) argued a student's perception determines the utility value, which would include the relevance of the coursework in some immediate way or how it will help them in life, in general, or their career.

To that end, Voelkl (1996) professed a major problem with United States youth were their emotional and physical withdrawal from school due to the belief that school did not meet their life needs. More recently, Humphreys and Davenport (2005) found students perceived some aspects of the college curricula (i.e., service learning) distracted from their self-development (maturity, time management skills, work habits, self-discipline and teamwork skills). Furthermore, Humphreys and Davenport found college students thought the general education requirements were a distraction from their major coursework and were not pleased with the options the colleges were offering to meet their needs in those areas.

Belongingness also impacts a student's perception of school (Voelkl, 1996*). "Belongingness is represented by feelings that one is a significant member of the social community, is accepted and respected in school, has a sense of inclusion in school, and includes school as part of one's self-definition"* (Voelkl, 1996, p. 762). Osterman (2000) suggested belonging is an important component in understanding student behavior and performance. According to Voelkl (1996), students who do not identify with school are the students who are less successful and show negative learning behaviors (i.e., low levels of classroom participation, low levels of involvement in academic activities, lowered academic motivation and attention, skipping class and being disruptive). Osterman (2000) found the experience of belongingness was important at all ages and all grade levels. Osterman also stated little evidence shows sense of belonging being directly related to achievement, but considerable evidence suggests sense of belonging influences achievement through the effects on engagement. Addressing needs related to belonging should aid in improving motivation, behavior and learning (Osterman, 2000).

With that in mind, *"students' feelings of identification and participation in classroom activities may be part of a cycle that promotes or detracts from academic achievement"* (Voelkl, 1996, p. 761). For students to engage in their education, they must value the experience of learning regardless of their interest in the topics or activities at hand (Deci et al., 1991). Long term, a college education generally has a positive indirect effect on job satisfaction via influences such as job prestige, income, job autonomy and non-routine work (Pascarella and Terenzini, 2005). College major may affect job satisfaction, which could be mediated by working in the field studied and income (Wolniak and Pascarella, 2005). Students select a major field of study with the anticipation that upon graduation they will work in that field (Robst, 2007). Wolniak and Pascarella (2005) stated those who *"majored in a high income field or perceived their job to be related to their major had significantly greater job satisfaction indirectly by way of income"* (p. 243). In contrast, some students place little value on their college education, though a majority believe the college experience to be of value (Humphreys and Davenport, 2005).

Purpose and Objectives

The purpose of this study was to examine undergraduate agricultural sciences and natural resource students' reasons for engaging in academic tasks at a land-grant university. The following objectives framed the research reported here:

1. Describe the goal orientations of undergraduate students in the College of Agricultural Sciences and Natural Resources at the University of Tennessee.
2. Determine the influence of academic efficacy, academic self-handicapping and skepticism about the relevance of school for future success on achievement goal orientation.

Methodology

Research Design, Population and Sample

This study was part of a larger study investigating undergraduate student motivation, metacognition and engagement in academic tasks. The research design was descriptive survey research. The target population of this study was all undergraduate students (N=1,286) in the College of Agricultural Sciences and Natural Resources at the University of Tennessee. The sample was a convenience sample of 303 undergraduate students or 24% of the target population. The sample consisted of 88 males and 215 females. The average age of the sample was 21.6 years old (*M*=21.6, *SD*=4.73) with a range of 18-49 years old. The class level of the

sample was 20% freshman, 18% sophomores, 28% juniors and 34% seniors. The mean grade point average of these students was 3.28 (*SD*=0.68) on a four-point scale. Participants described their ethnicity as: 1% American Indian or Alaskan Native, 1% as Asian, 7% as Black or African American, 1% as Native Hawaiian or Other Pacific Islander, 87% as White and 3% as Spanish/Hispanic/Latino. The sample was compared to the known demographic variables of ethnicity, class level, major and gender and was found to be representative based on ethnicity, class level and major. However, the sample was skewed towards females and was weighted based on the population parameter.

Instrumentation

The researcher-developed questionnaire consisted of five sections: (a) six demographic questions, the 12 item Achievement Goal Questionnaire (Elliot and Murayama, 2008), the five item Academic Efficacy Scale (Midgley et al., 2000), the six item Academic Self-handicapping Strategies Scale (Midgley et al., 2000), the six item Skepticism About the Relevance of School for Future Success Scale (Midgley et al., 2000) and 24 survey questions not reported on in this article. Minor wording changes were made to the Achievement Goal Questionnaire, Academic Efficacy Scale and Academic Self-handicapping Strategies Scale to fit the context of the study. For example, "I'm certain I can master the skills taught in class this year" was changed to "I'm certain I can master the skills taught in my classes this year" and "Even if I do well in school, it will not help me have the kind of life I want when I grow up" was changed to "Even if I do well in school, it will not help me have the kind of career I want when I graduate." We modified the wording to include all classes taken by the students and focus on their desired career after graduation instead of life.

The Achievement Goal Questionnaire consisted of four constructs and Elliot and Murayama (2008) reported Cronbach's alpha coefficient of 0.84 for the mastery-approach, 0.88 for the mastery-avoidance, 0.92 for the performance-approach and 0.94 for the performance-avoidance. Elliot and Murayama also reported structural validity of the four constructs was assessed using confirmatory factor analytic techniques and the structural validity was confirmed. Midgley et al. (2000) reported Cronbach's alpha coefficients for academic efficacy as 0.78, 0.84 for the academic self-handicapping strategies and 0.83 for skepticism about the relevance of school for future success. The post-hoc reliabilities for each construct were: 0.91 for academic efficacy, 0.87 for self-handicapping, 0.88 for skepticism, 0.81 for mastery-approach, 0.74 for master-avoidance, 0.81 for performance-approach and 0.83 for performance-avoidance. The Achievement Goal Questionnaire utilized a rating scale for each construct of 1 = strongly disagree to 5 = strongly agree. The scales from Midgley et al. used a different rating scale: 1 = not at all true to 5 = very true. Six cognitive interviews were conducted with individuals of the target population and they were not included in the study. Dillman et al. (2009) recommended conducting cognitive interviews to identify wording, design and navigation issues. Based on the cognitive interviews, changes were made to survey directions and to questions which were part of the larger study to improve clarity, flow and understanding of the questionnaire.

Data Collection

Data for this study were collected during the fall semester at the University of Tennessee using the online Qualtrics Survey software. The questionnaire was sent electronically to the undergraduate students using their university email accounts. Dillman et al.'s (2009) procedures for implementing web surveys guided the multiple contacts made. Four emails were sent through the Qualtrics Survey software approximately one week apart to all College of Agricultural Sciences and Natural Resources students. The first email was sent to inform the entire population of the study. The second email contained the link to the survey and the online informed consent. If the students chose to participate in the study, they digitally signed the informed consent by clicking, they voluntarily agree to participate in the study and I have read the informed consent. The third and fourth emails were sent as a reminder to the students of the opportunity to participate in the study and both contained the link to the survey. The survey took approximately 10-15 minutes to complete and this research was approved by the University of Tennessee's Institutional Review Board.

Data Analysis

Descriptive statistics were used to summarize demographic information. Summated means were calculated for the following constructs: (a) mastery-approach, (b) mastery-avoidance, (c) performance-approach, (d) performance-avoidance, (e) academic efficacy, (f) academic self-handicapping strategies and (g) skepticism about the relevance of school for future success. A multivariate Tobit regression was used to determine if academic efficacy, academic self-handicapping and skepticism about the relevance of school for future success could predict achievement goal orientation. The Tobit model restricts the dependent variable to always be greater than zero and the multivariate estimation considers the correlation of the unexplained factors captured in the error term that impact the achievement goal orientation (Greene, 2008).

Methodological Limitations

The findings of this study may not be generalizable beyond the target population – undergraduate students in the College of Agricultural Sciences and Natural Resources at the University of Tennessee. Therefore, readers should use caution when generalizing the results of this study unless data confirms the target population of this study is representative of other populations of undergraduate students.

Results

Objective 1: Describe the goal orientations of undergraduate students in the College of Agricultural Sciences and Natural Resources at the University of Tennessee.

As shown in Table 1, the summated means for mastery-approach, mastery-avoidance, performance-approach and performance-avoidance were 4.42 (*SD*=0.03), 3.79 (*SD*=0.05), 4.18 (*SD*=0.05) and 4.07 (*SD*=0.05), respectively. Students' highest goal orientation was mastery-approach and lowest was mastery-avoidance, which indicates students are least concerned with avoiding task-based or intrapersonal incompetence. In regard to performance, students' goal orientations are similar. Overall, the small range in mastery and performance goal orientations (3.79 to 4.42) indicates the students are focused on achieving and avoiding personal and normative competence and incompetence. This is further supported by majority agreement on all items of the Achievement Goal Questionnaire (Elliot and Murayama, 2008; Table 2).

Objective 2: Determine the influence of academic efficacy, academic self-handicapping and skepticism about the relevance of school for future success on achievement goal orientation.

Parameter estimates for academic efficacy were positive and significantly predicted mastery-approach (β_{AE}=0.36, p<0.05), mastery-avoidance (β_{AE}=0.27, p<0.05) and performance-approach (β_{AE}=0.29, p<0.05). Academic efficacy did not significantly predict performance-avoidance (β_{AE}=0.05, p>0.05). Parameter estimates for self-handicapping were negative and significantly predicted mastery-approach (β_{SH}= –0.18; p<0.05), mastery-avoidance (β_{SH}= –0.22, p<0.05), performance-approach (β_{SH}= –0.19, p <0.05) and performance-avoidance (β_{SH}= –0.23, p <0.05). Parameter estimates for skepticism were negative and did not significantly predict (p>0.05) the achievement goal orientations (Table 3). The error terms for each of the achievement goal orientations were significantly correlated, suggesting that unexplained factors that impact the achievement goal orientations were positively correlated and that the multivariate Tobit model is appropriate.

Table 1. Summary Statistic of Achievement Goal Orientations

Goal Orientation	M	SD
Mastery-Approach	4.42	0.03
Mastery-Avoidance	3.79	0.05
Performance-Approach	4.18	0.05
Performance-Avoidance	4.07	0.05

Note. 1 = *strongly disagree* to 5 = *strongly agree*.

Summary, Discussion and Recommendations

This study sought to describe the achievement goal orientation of undergraduate College of Agricultural Sciences and Natural Resources students at University of Tennessee and determine the influence of academic efficacy, academic self-handicapping and skepticism about the relevance of school for future success. Overall, the undergraduate students possessed multiple reasons for engaging in academic tasks as indicated by the majority agreement on all items representing the four achievement goal orientations and the summated achievement goal orientation means. Thus, the undergraduate agricultural sciences and natural resource students use intrapersonal and social comparisons to attain competence or avoid incompetence

Table 3. Summary of Parameter Estimates for Academic Efficacy, Academic Self-handicapping, and Skepticism about the Relevance of School for Future Success as Predictors of Achievement Goal Orientation

Parameter Estimates	Mastery-Approach	Mastery-Avoidance	Performance-Approach	Performance-Avoidance
Intercept	3.56***	3.23***	3.74***	4.65***
Academic Efficacy	0.36***	0.27***	0.29***	0.05
Self-Handicapping	-0.18**	-0.22*	-0.19*	-0.23*
Skepticism	-0.07	-0.02	-0.13	-0.09
Sigma	0.68***	1.07***	0.96***	1.18***
Correlation Estimates				
Mastery-Approach	-	0.40***	0.42***	0.32***
Mastery-Avoidance	0.41***	-	0.30***	0.54***
Performance-Approach	0.42***	0.30***	-	0.72***
Performance-Avoidance	0.32***	0.54***	0.72***	-

Note. *p<.05, **p<.01, ***p<.001.

Table 2. Descriptive Statistics for Goal Orientation Items

Items	Strongly Disagree %	Disagree %	Neither Agree nor Disagree %	Agree %	Strongly Agree %
Mastery-Approach					
My aim is to completely master the material presented in my coursework.	1.00	2.00	4.67	50.00	42.33
I am striving to understand the content in my coursework as thoroughly as possible.	1.34	1.34	3.68	44.82	48.83
My goal is to learn as much as possible.	0.34	1.68	3.02	34.90	60.07
Mastery Avoidance					
My aim is to avoid learning less than I possibly could.	9.48	10.35	17.50	35.49	27.17
I am striving to avoid an incomplete understanding of the course material.	3.09	2.65	7.11	48.00	39.14
My goal is to avoid learning less than it is possible to learn.	7.94	9.82	21.13	38.00	23.10
Performance-Approach					
My aim is to perform well relative to other students	9.48	10.35	17.50	35.49	27.17
I am striving to do well compared to other students.	3.09	2.65	7.11	48.00	39.14
My goal is to perform better than the other students.	3.00	6.36	20.12	31.50	39.03
Performance-Avoidance					
My aim is to avoid doing worse than other students.	2.99	5.26	17.05	37.54	37.18
I am striving to avoid performing worse than others.	2.64	4.91	17.25	39.48	35.72
My goal is to avoid performing poorly compared to others.	3.28	5.28	9.48	33.42	48.54

while self-regulating their learning. This finding is consistent with Daniels et al. (2008), Hidi and Harackiewicz (2000), Law et al. (2012) and Ormrod (2012). However, the students were more oriented toward mastery-approach and least oriented toward mastery-avoidance. This suggests the undergraduate students were more concerned with attaining task-based or intrapersonal competence than avoiding task-based or intrapersonal incompetence. Furthermore, the students possessed similar orientations regarding performance-approach and performance-avoidance, which is consistent with Law et al. (2012). This suggests students were nearly equally motivated to attain normative competence and avoid normative incompetence. This may indicate that the undergraduate agricultural sciences and natural resource students at the University of Tennessee were concerned with immediate and long-term motivations for learning such as grades and career proficiency. We recommend instructors utilize immediate and long-term motivations during the teaching and learning process. Based on the finding that the undergraduate students possessed all the achievement goal orientations, explicitly connecting course content, assignments and tasks to prior knowledge, assessments and learning experiences and to future use should support the students' immediate and long-term learning and performance goals. Theoretically, this ought to positively influence what and how students learn (Ormrod, 2012; Schunk, 2012). Future research should investigate best practice on how to teach students with multiple goal orientations. This may be particularly important in colleges of agriculture where most students are in pre-professional majors like the College of Agricultural Sciences and Natural Resources at the University of Tennessee. These students may possess multiple goal orientations due to the pressure to master the content and outperform their peers. Future research should also seek to determine if students in non-pre-professional majors exhibit fewer goal orientations. This study did not distinguish between the pre-professional and non-pre-professional students and this could also have implications on how courses should be taught based upon students' motivations for engaging in academic tasks. In addition, utilizing cooperative learning techniques may reduce competition and focus students' efforts on mastery learning (Schunk, 2012). For that reason, future research should explore the effects of cooperative learning on social/normative comparisons.

Academic efficacy had a positive impact and was a significant predictor of mastery-approach, mastery-avoidance and performance-approach orientations but was not a significant predictor of performance-avoidance. Consistent with goal theory (Schunk, 2012), academic efficacy had a direct relationship with the achievement goal orientations. Instructors should be cognizant of this and that self-efficacy mediates achievement gains (Putwain et al., 2013; Schunk, 2012). As a result, instructors should judiciously provide academic feedback that supports achievement motivation and skill acquisition. This feedback can encourage self-regulation (Ormrod, 2012; Schunk, 2012; Zimmerman and Cleary, 2009) and aid the learner in sustaining motivation for learning and for tasks associated with teaching and learning (Ormrod, 2012; Schunk, 2012; Schunk and Swartz, 1993a, 1993b). Instructors should also keep in mind that learning success should positively impact academic efficacy and thus, students are likely to put forth more effort, persist when presented with challenging learning related task, engage in effective learning strategies and develop intrinsic motivation for learning (Bandura, 1986; Ormrod, 2012; Schunk, 2012). Therefore, we recommend instructors scaffold complex tasks or skills to allow students opportunities to build or support their academic efficacy and to make and gauge progress in knowledge and skill acquisition. To accomplish this, instructors will need to thoroughly vet their assignments and educational tasks against course objectives and desired learning outcomes.

Self-handicapping had a negative effect and was a significant predictor of all four achievement goal orientations. Thus, self-handicapping had an inverse relationship with the achievement goal orientations. Providing high-quality feedback may also be important for students who tend to self-handicap, since self-handicappers tend to display uncertainty in their ability (Zuckerman and Tsai, 2005). High-quality feedback may aid self-handicappers in properly evaluating their present level of mastery and performance and encourage mastery goal setting. This is relevant because students who exhibit mastery goal orientations generally engage in activities that aid in knowledge and skill acquisition (Ames and Archer, 1988; Nolen, 1988, 1996; Ormrod, 2012; Schunk, 2012). Also, to help prevent underachievement, instructors may want to design assignments that build upon each other, when appropriate and are worth a smaller percentage of points in relation to overall possible points for a course as self-handicapping is more frequent when value or importance increases (McCrea, 2008). However, the knowledge base regarding how instructors positively or negatively influence self-handicapping is spare. Thus, future research is warranted and should seek to reduce the behavior. Future research should consider learner, teacher and environmental variables (Bandura, 1986; Bransford et al., 2000; Dunkin and Biddle, 1974; Schunk, 2012) and their influence on self-handicapping.

Skepticism about the relevance of school for future success had a negative effect but was not a significant predictor of the achievement goal orientations. Therefore, for undergraduate students in the College of Agricultural Sciences and Natural Resources at the University of Tennessee, skepticism about the relevance of school for future success did not explain a significant portion of the variance in the achievement goal orientations. The negative effect is to be expected given the fact relevance of subject matter influences students' approaches to learning (Ames, 1992; Good, 1983), perceptions of career readiness and self-develop-

ment (Humphreys and Danenport, 2005; Voelkl, 1996) and theoretically course expectations and reasons for engaging in academic tasks (Schunk, 2012). However, the results of this study suggest, the effect of skepticism about the relevance of school for future success may not be an area of concern for instructors at the University of Tennessee.

In summary, instructors in the College of Agricultural Sciences and Natural Resources at the University of Tennessee should focus more attention to supporting/improving academic efficacy and reducing self-handicapping behaviors than skepticism about the relevance of school for future success. Additionally, based on the results of this study, we recommend administrators provide professional development opportunities or opportunities for instructors to attend professional development on academic efficacy and self-handicapping. Moreover, we recommend this study be replicated in other colleges of agriculture to see if those populations of undergraduate students possess similar goal orientations and explanatory factors. Future research should also seek to determine other explanatory factors that influence achievement goal orientations and investigate instructional strategies and educational practices that help students to develop mastery goals for learning. This information can be used to improve undergraduate instruction and may prove to be a critical component as we strive to prepare students to be science professionals and well informed citizens.

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Comprehensive Study of Undergraduate Student Success at a Land Grant University College of Agricultural Sciences, 1990-2014.

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Abstract

The United States Department of Agriculture and others have identified the need for educated agriculturalists. Given the financial constraints of most institutions, it is important that decision makers are strategic in our programming. This study offers a rigorous and systematic approach to assess programmatic needs in three segments. Using Colorado State University (CSU) as a case study for this systematic assessment, CSU was found to not represent the state it serves, Colorado. Further, statistically significant opportunity gaps were found for gender, Pell eligibility, first generation status, residency and minority students. Finally, the first year retention, four-year graduation rate and six-year graduation rate predictive models provided evidence for program investment to support first generation, minority and resident students. Of note, non-minority students were found to be 1.78 times more likely to graduate in four years than were minority students. Minority students were 53% less likely to graduate than majority students in six years. First generation students were less likely than non-first generation students to graduate in six years and residents were more likely to graduate than non-residents of the state within the six-year time frame.

Introduction

In recent years, there has been a noted shift in the demographics of students who study agricultural sciences, in particular, animal sciences (Buchanan, 2008; Burk et al., 2013). This documented shift toward more women, more ethnically diverse students and students from non-rural communities is likely to increase. According to the United States (US) Census Bureau, the US is projected to become more ethnically and racially diverse (US Census Bureau, 2015). The Hispanic (Latino) population alone is projected to grow from 17.4% in 2014 to 28.6% in 2060 while it is projected that 64.4% of people under 18 will identify as Hispanic in 2060 versus 48% in 2014.

These statistics confirm what those in higher education have been predicting. In March of 2013 readers of The Chronicle of Higher Education were alerted that *"sharply increasing diversity will soon hit many states and institutions with freight-train force"* (Hoover, 2013). Further, Hoover stated that *"as these changes take hold, meeting the needs of minority students, especially those from underrepresented groups, will play a greater role in defining institutional success."* If institutions of higher education are to be prepared for this "freight-train", it is important to assess both historical and current educational trends for our students, including our minority students, to objectively guide educational efforts.

Meanwhile, the United States Department of Agriculture and others have identified the need for educated agriculturalists ("Education," n.d.; "How to Feed the World in 2050", n.d.). Universities, particularly Land Grant institutions need to identify how to both recruit and successfully graduate people prepared to lead as professional agriculturalists (Fogel, 2012; Association of Public Land-Grant Universities, [APLU], 2009). There are not enough people graduating with degrees in agricultural fields (APLU, 2009; Jones and Larke, 2001). It is a foundational assumption of this research that those who have been a part of agricultural labor are a critical answer to the societal need for educated agriculturalists; there is space for all, including Hispanics and other ethnic groups, in agricultural education and not just in the labor pool.

Given the financial constraints of most institutions, it is important that we are strategic in our programming to support undergraduate students. Most institutions do not have the luxury of such abundant resources that they can address all possible opportunity gaps. Instead, we need to prioritize our programming. Perhaps the most prevailing inequalities in agricultural higher education are associated with ethnicity, gender, socio-economic status, residency and first generation status. Perhaps

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these opportunity gaps have remained consistent over the past twenty years. The problem is that we do not yet have a standardized and systematic approach to assessing whether or which opportunity gaps exist in our Colleges of Agricultural Sciences (CAS) as Land Grant institutions. The purpose of this study is to thoroughly examine agricultural higher education demographics at one Land Grant institution from 1990-2014 to guide future program investment. In so doing, this approach may also be employed by other Land Grant institutions wherein we could benchmark and set growth goals for both recruitment and retention.

Methods

A descriptive, non-experimental and comparative quantitative research approach is employed (Morgan et al., 2009; Morgan et al., 2011). This study uses anonymized secondary data provided to the researchers from the university's institutional research office and received approval via the Internal Review Board to conduct the analysis. The analysis includes three distinct segments. First, this study compared quantitatively the demographics of those studying agriculture at a Land Grant university, CSU as the case study, over a 24-year period and assess whether these demographics are reflective of the overall population of the state of the institution, Colorado. Second, this study employed statistical tests of difference to assess opportunity gaps for retention to second year, first year grade point average (GPA), final or current GPA, four-year graduation rate and six-year graduation rate for gender, Pell eligibility (data available for years 1992–2014), first generation status, residency status and ethnicity as defined by majority (White) and minority (non-White). The third segment focused on recent trends and utilized logistic regression analysis of the data for students who began in the fall semesters of 2003 through 2008.

In the first segment, demographics of the undergraduate populations within CSU's CAS were investigated to determine the gender and ethnic representation between 1990 and 2014. Second, the demographics of the CAS were compared numerically and visually with those of the Colorado. Theoretically, the most valid method for this comparison is using a visual aid such as a pie chart to depict the demographic differences because the data sets used for this investigation are separate from and unrelated to the state's census data set (Huck, 2008; Thompson, 2008). To honor this theoretical construct, pie charts were developed to show the ethnic percentages for Colorado in 1990, 2000 and 2010, compared to the ethnic percentages for the University's CAS undergraduate students in similar years. Of note, in 2010 Colorado census participants could select more than one ethnicity. Further, a statistical test was desired to quantify any observed differences. To explore differences statistically, expected frequencies were calculated for the CAS 1990, 2000 and 2010 data sets to match the demographics of the state. A Chi Square Goodness of Fit test was then employed to compare the ethnic percentages observed in the comparison years for the CSU CAS undergraduate students to what is expected if the CAS is representative of Colorado's ethnic demographics. (Morgan et al., 2011; Morgan et al., 2009). Finally, to test whether the calculated ratio of Colorado population percentage as compared to the CSU CAS population percentage representation for the largest minority population in the state, Hispanics/Latinos, has changed over time, such ratios were calculated for 1990, 2000 and 2010.

In the second segment, independent samples t tests were run to investigate first year GPA and final or current GPA opportunity gaps (difference) for the CAS undergraduate population between 1990 and 2014. Pearson Chi Square tests were run to investigate retention to second year, four-year graduation and six-year graduation opportunity gaps for the CAS undergraduate population between 1990 and 2014. The level of significance was set to 99% to insure the investigation against Type 1 error (Morgan et al., 2011; Morgan et al., 2009). The first round of t tests asked if there was a difference in first year GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. The second round of t tests asked if there was a difference in final/current GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. The first round of Chi-Square tests asked if there was a difference in retention to the second year for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. In the Chi-Square statistics for retention to the second-year study abroad students were counted as retained and the one deceased student was counted as not retained. The second round of chi square tests asked if there was a difference in four-year graduation rates for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. Finally, the third round of t-tests asked if there was a difference in six-year graduation rates for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students.

The third segment focuses on recent trends for the undergraduate students. The analysis used data from the cohorts entering in the fall semesters of 2003 through 2008 in three separate step wise logistic regression models to assess whether the predictor variables of gender, ethnicity (minority/majority), residency status, Pell eligibility and first generation status are significant predictors for retention to second year, four-year graduation, or six-year graduation.

Table 1. Ethnicity percentages

Source	European American/White	Hispanic/ Latino	Asian/Pacific Islander	African American	Native American	Other
Colorado in 1990	80.7%	12.9%	1.8%	4.0%	0.8%	5.1%
1990 CAS undergraduate students	90.1%	2.2%	2.6%	0.7%	0.7%	5.3%
Colorado in 2000	74.5%	17.1%	2.3%	3.8%	1.0%	7.2%
2000 CAS undergraduate students	87.6%	3.2%	2.5%	0.7%	1.9%	4.2%
Colorado in 2010	81.3%	20.7%	2.9%	4.0%	1.1%	7.2%
2010 CAS undergraduate students	85.3%	4.7%	0.9%	0.2%	0.6%	6.0%

Results

Segment 1: Statistical Differences for Ethnicity Representation within the CSU CAS as compared to the demographics of Colorado

Table 1 shows the ethnicity percentages for Colorado based on the 1990, 2000 and 2010 census. For comparative purposes, Table 1 also shows the ethnicity percentages for the 1990, 2000 and 2010 CAS undergraduate students. It is visually obvious that CAS demographics are not similar in ethnic composition of Colorado in 1990, 2000 and 2010. A statistical test is not necessary to observe, for example, that in 1990 2.2% of the CSU CAS undergraduate population was Hispanic/ Latino while the Hispanic/Latino population for the state was 12.9%. One can also distinguish a difference in 2000 between the Hispanic/Latino for Colorado, 17.1% and the Hispanic/Latino representation in the College, 3.2%. Again, in 2010, the difference between the 20.7% Hispanic/Latino population for the state of Colorado and the 4.7% Hispanic/Latino representation for the 2010 undergraduate students is readily observable.

To further illustrate whether CAS demographics were similar in ethnic composition of Colorado, the results from Chi Square Goodness of Fit tests are shown in Table 2. For 1990, 2000 and 2010 the CAS Hispanic/Latino and African American undergraduate representation is significantly lower than expected. For Asians/Pacific Islanders (combined) the Chi Square results were significant in 2010. In 2010, Asian student representation within CAS was less than expected and Pacific Islander representation was more than expected. In 2000, the Native American population was significantly lower than expected.

Finally, to test whether the calculated ratio of Colorado population percentage as compared to the CSU CAS population percentage representation for the largest minority population in the state, Hispanics/ Latinos, has changed over time, such ratios were calculated for 1990, 2000 and 2010. In 1990 the ratio is 5.9, in 2000 the ratio is 5.3 and in 2010 the ratio is 4.4. The relative representation of the CSU CAS is decreasing, that is, CSU's CAS was more representative of the state of Colorado in 1990 than it was in 2010.

Segment 2: Opportunity Gaps for CAS Undergraduate Students 1990-2014

Table 3 presents the results of the first round of t-tests which queried if there was a difference in first year GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students; *d* is also shown as an interpretation of the strength of the relationship or effect size (Morgan et al., 2011; Morgan et al., 2009; Cohen, 1988). At the $p<0.01$ level, males had a significantly lower first year GPA than female, students not eligible for Pell grants had a significantly higher first year GPA than students eligible for Pell grants, non-first generation students had a significantly higher first year GPA than first generation students, residents had a significantly lower first year GPA than non-residents and majority students had a significantly higher first year GPA than minority undergraduates. For all the first-year GPA t-test results the effect size was small or smaller than typical. Table 4 presents the results of the second round of t tests which asked if there was a difference in final/current GPA for females/ males, Pell eligible/non-eligible, first generation students/non-first generation students, residents of Colorado/non-residents and majority/minority students. At the $p<0.01$ level, males had a significantly lower final/ current GPA than females, students not eligible for Pell grants had a significantly higher final/current GPA than students eligible for Pell grants, non-first generation students had a significantly higher final/current GPA than

Table 2. Chi Square Goodness of Fit analysis comparing observed demographics within the CAS undergraduate population with the demographics of State

Ethnic Population	1990 CAS Undergraduates	2000 CAS Undergraduate	2010 CAS Undergraduates
Hispanic/Latino	χ^2=67.0	χ^2=158.8	χ^2=156.5
Asian/Pacific Islander	χ^2=2.4	χ^2=0.2*	Asian: χ^2=16.7 Pacific Islander: χ^2=5.6*
African American	χ^2=21.2	χ^2=35.3	χ^2=42.2
Native American	χ^2=0.2	χ^2=10.0	χ^2=2.5

*CAS representation greater than expected as compared to Colorado's population

Table 3. Independent t test analysis for differences in first year grade point average for CAS undergraduate students for multiple demographics

Tested demographic	Mean GPA	t	99% Confidence Interval	*d*
Male/female	2.8/3.0	-6.8*	-0.24 - -0.11	0.03
Pell eligible/not eligible	2.9/3.0	2.9*	0.01 – 0.19	0.15
First generation/not first generation	2.9/3.0	3.1*	0.01 – 0.14	0.12
Residents/non-residents	2.9/3.0	-2.7*	-0.12 - -0.003	0.09
Majority/minority	3.0/2.8	4.2*	0.06 – 0.26	0.23

*Significant at P<0.01

Table 4. Independent t-test analysis for differences in final or current grade point average for CAS undergraduate students for multiple demographics

Tested demographic	Mean GPA	t	99% Confidence Interval	*d*
Male/female	2.7/2.9	-5.0*	-0.22 - -0.07	0.18
Pell eligible/not eligible	2.7/2.9	3.7*	0.04 – 0.25	0.18
First generation/not first generation	2.7/2.9	4.9*	0.07 – 0.21	0.17
Residents/non-residents	2.9/2.9	-1.7	-0.11 – 0.02	0.05
Majority/minority	2.9/2.7	4.6*	0.08 – 0.29	0.22

*Significant at P<0.01

first generation students, majority students had a significantly higher final/current GPA than minority undergraduates. No significant difference in final/current GPA was found for residents/non-residents. For all final/current GPA t-test results the effect size was small or smaller than typical.

To investigate whether females and males differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 5 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=0.03, df=1, n=4135, p=0.9). Females are not more likely than expected under the null hypothesis to have low or high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.003. The retention to second year rate for females was 85.6% and the retention to second year rate for males was 85.8%.

To investigate whether Pell eligible and non-eligible students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 6 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=6.34, df=1, n=4135, p=0.01). Pell eligible are more likely than expected under the null hypothesis to have low rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.003, which is a small or smaller than typical effect size. The retention to second year rate for Pell eligible students was 82.1% and the retention to second year rate for non-Pell eligible students was 86.2%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 7 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=22.84, df=1, n=4135, p=0.001). First generation students are more likely than expected under the null hypothesis to have low rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.074, which is a small or smaller than typical effect size. The retention to second year rate for first generation students was 81.6% and the retention to second year rate for non-first generation students was 87.4%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 8 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=6.27, df=1, n=4135, p=0.01). Residents are more likely than expected under the null hypothesis to have high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.039, which is a small or smaller than typical effect size. The retention to second year rate for residents was 87.0% and the retention to second year rate for non-residents was 84.3%.

Table 5. Pearson Chi Square analysis of prevalence in retention to second year for CAS undergraduate students among females and males

		Gender			
Variable	n	Males	Females	χ^2	*p*
Retention to 2nd year				0.03	0.9
Yes	3544	1008	2536		
No	591	166	425		
Totals	4135	1174	2961		

Table 6. Pearson Chi Square analysis of prevalence in retention to second year for Pell eligible and non-Pell eligible CAS undergraduate students

		Pell			
Variable	n	Non-eligible	Eligible	χ^2	*p*
Retention to 2nd year				6.34	0.01
Yes	3544	3123	421		
No	591	499	92		
Totals	4135	3622	513		

Table 7. Pearson Chi Square analysis of prevalence in retention to second year for first generation and non-first generation CAS undergraduate students

		First Generation			
Variable	n	No	Yes	χ^2	*p*
Retention to 2nd year				22.84	0.001
Yes	3544	2577	967		
No	591	373	218		
Totals	4135	2950	1185		

Table 8. Pearson Chi Square analysis of prevalence in retention to second year for residents of Colorado and non-residents of the CAS undergraduate students

		Residency of Colorado			
Variable	n	No	Yes	χ^2	*p*
Retention to 2nd year				6.27	0.01
Yes	3544	1674	1870		
No	591	312	279		
Totals	4135	1986	2149		

Table 9. Pearson Chi Square analysis of prevalence in retention to second year for majority and minority CAS undergraduate students

		Race			
Variable	n	Majority	Minority	χ^2	*p*
Retention to 2nd year				2.30	0.130
Yes	3544	3152	392		
No	591	513	78		
Totals	4135	3665	470		

To investigate whether majority and minority students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 9 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=2.30, df=1, n=4135, p=0.130). Majority students are not more likely than expected under the null hypothesis to have low or high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.024. The retention to second year rate for majority students was 86.0% and the retention to second year rate for minority students was 83.4%.

To investigate whether females and males differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 10 shows the

Pearson Chi-Square results and indicates that there is a significant association (χ^2=11.962, df=1, n=4135, p=0.001). Females are significantly more likely than expected under the null hypothesis to have high four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.054, which is a small or smaller than typical effect size. The four-year graduation rate for females was 36.6% and the four-year graduation rate for males was 30.9%.

To investigate whether Pell eligible and non-Pell eligible students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 11 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=19.389, df=1, n=4135, p=0.001). Pell eligible undergraduate students are more likely than expected under the null hypothesis to have low rates four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.068, which is a small or smaller than typical effect size. The four-year graduation rate for Pell eligible students was 26.3% and the four-year graduation rate for non-Pell eligible students was 36.2%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 12 shows the Pearson Chi-Square results and indicates that there is not a significant association at the 99% confidence level (χ^2=4.580, df=1, n=4135, p=0.032). Phi, which indicates the strength of the association between the two variables, is 0.033. The four-year graduation rate for first generation students was 32.5% and the four-year graduation rate for non-first generation students was 36.0%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 13 shows the Pearson Chi-Square results and indicates that there is not a significant association at the 99% confidence level (χ^2=5.514, df=1, n=4135, p=0.019). Phi, which indicates the strength of the association between the two variables, is 0.037. The four-year graduation rate for residents was 36.7% and the four-year graduation rate for non-residents was 33.2%.

To investigate whether majority and minority students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 14 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=36.078, df=1, n=4135, p=0.001). Majority students are significantly more likely than expected under the null hypothesis to have high four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.093, which is a small or smaller than typical effect size. The four-year graduation rate for majority students was 36.6% and the four-year graduation rate for minority students was 22.6%.

To investigate whether females and males differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 15 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=2.313, df=1, n=4135, p=0.128). Females are not more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.024. The six-year graduation rate for females was 54.2% and the six-year graduation rate for males was 56.8%.

To investigate whether Pell eligible and non-Pell eligible students differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 16 shows the Pearson Chi-Square results and indicates

Table 10. Pearson Chi-Square analysis of prevalence in four-year graduation rates for CAS undergraduate students among females and males

		Gender			
Variable	n	Males	Females	χ^2	*p*
Four-year graduation				0.03	0.9
Yes	1447	363	1084		
No	2688	811	1877		
Totals	4135	1174	2961		

Table 11. Pearson Chi-Square analysis of prevalence in four-year graduation rates for Pell eligible and non-Pell eligible CAS undergraduate students

		Pell			
Variable	n	Non-eligible	Eligible	χ^2	*p*
Four-year graduation				19.389	0.001
Yes	1447	1312	135		
No	2688	2310	378		
Totals	4135	3622	513		

Table 12. Pearson Chi-Square analysis of prevalence in four-year graduation rates for first generation and non-first generation CAS undergraduate students

		First Generation			
Variable	n	No	Yes	χ^2	*p*
Four-year graduation				4.580	0.032
Yes	3544	2577	967		
No	591	373	218		
Totals	4135	2950	1185		

Table 13. Pearson Chi-Square analysis of prevalence in four-year graduation rates for residents and non-residents of the CAS undergraduate students

		Residency of Colorado			
Variable	n	No	Yes	χ^2	*p*
Four-year graduation				5.514	0.019
Yes	1447	659	788		
No	2688	1327	1361		
Totals	4135	1986	2149		

Table 14. Pearson Chi-Square analysis of prevalence in four-year graduation rates for majority and minority CAS undergraduate students

		Race			
Variable	n	Majority	Minority	χ^2	*p*
Four-year graduation				36.078	0.001
Yes	1447	1341	106		
No	2688	2324	364		
Totals	4135	3665	470		

Table 15. Pearson Chi-Square analysis of prevalence in six-year graduation rates for CAS undergraduate students among females and males

		Gender			
Variable	n	Males	Females	χ^2	*p*
Six-year graduation				2.313	0.128
Yes	2272	667	1605		
No	1863	507	1356		
Totals	4135	1174	2961		

Table 16. Pearson Chi-Square analysis of prevalence in six-year graduation rates for Pell eligible and non-Pell eligible CAS undergraduate students

		Pell			
Variable	n	Non-eligible	Eligible	χ^2	*p*
Six-year graduation				55.921	0.001
Yes	2272	2069	203		
No	1863	1553	310		
Totals	4135	3622	513		

Table 17. Pearson Chi-Square analysis of prevalence in six-year graduation rates for first generation and non-first generation CAS undergraduate students

		First Generation			
Variable	n	No	Yes	χ^2	*p*
Six-year graduation				21.517	0.001
Yes	2272	1688	584		
No	1863	1262	601		
Totals	4135	2950	1185		

Table 18. Pearson Chi-Square analysis of prevalence in six-year graduation rates for residents of Colorado and non-residents of the CAS undergraduate students

		Residency of Colorado			
Variable	n	No	Yes	χ^2	*p*
Six-year graduation				16.141	0.001
Yes	2272	1027	1245		
No	1863	959	904		
Totals	4135	1986	2149		

Table 19. Pearson Chi-Square analysis of prevalence in six-year graduation rates for majority and minority CAS undergraduate students

		Race			
Variable	n	Majority	Minority	χ^2	*p*
Six-year graduation				40.022	0.001
Yes	2272	2078	194		
No	1863	1587	276		
Totals	4135	3665	470		

that there is a significant association (χ^2=55.921, df=1, n=4135, p=0.001). Pell eligible undergraduate students are more likely than expected under the null hypothesis to have low six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.116, which is a small or smaller than typical effect size. The six-year graduation rate for Pell eligible students was 39.6% and the six-year graduation rate for non-Pell eligible students was 57.1%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low six-year graduation rates a chi-square statistic was conducted. Assumptions were checked and were met. Table 17 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=21.517, df=1, n=4135, p=0.001). First generation undergraduate students are more likely than expected under the null hypothesis to have low six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.072, which is a small or smaller than typical effect size. The six-year graduation rate for first generation students was 49.3% and the six-year graduation rate for non-first generation students was 57.2%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 18 shows the Pearson Chi-Square results and indicates that there is a significant association at the 99% confidence level (χ^2=16.141, df=1, n=4135, p=0.001). Residents are more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.062, which is a small or smaller than typical effect size. The six-year graduation rate for residents was 57.9% and the six-year graduation rate for non-residents was 51.7%.

To investigate whether majority and minority students differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 19 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=40.022, df=1, n=4135, p=0.001). Majority students are significantly more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.098, which is a small or smaller than typical effect size. The six-year graduation rate for majority students was 56.7% and the six-year graduation rate for minority students was 41.3%.

Segment 3: Predictive models for CAS undergraduate student 2003-2008

Table 20 depicts the characteristic of the CAS undergraduate students in the cohorts entering in the fall semesters of 2003-2008. These variables (Minority, Gender, Resident, Pell Recipient, First Generation, Retained to Second Fall, Graduated in four years and Graduated in six years) were utilized to create predictive models through logistic regression analysis for retention to second fall, four-year graduation and six-year graduation.

Table 20. Characteristics of College of Agricultural Sciences undergraduate students, cohorts entering the university Fall 2003-2008. Variables listed were included in final models for prediction of retention to second fall, four-year graduation, and six-year graduation

Demographic Variable	Yes n (percentage)	No n (percentage)
Minority	120 (10.1%)	1066 (89.9%)
Female (Gender)	841 (71.0%)	344 (29.0%)
Resident	666 (56.2%)	519 (43.8%)
Pell Recipient	194 (16.4%)	991 (83.6%)
First Generation	368 (31.1%)	817 (68.9%)
Retained Second Fall	1019 (86.0%)	166 (14.0%)
Graduated in 4 years	501 (42.3%)	684 (57.5%)
Graduated in 6 years	799 (67.4%)	386 (32.6%)

Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict retention from first year to second year first semester defined as first-year retention rate. This model had little value since the zero-order model predicted 86% of the cases. In other words, most students went on to their second year so the variables added little to the by chance model. Nagelkerke squared was 0.04, so the model did improve by a few percentage points. (Chi-Square=27.07, $p<0.001$). Perhaps not surprisingly, non-first generation students were far more likely to be retained in the second year (Odds Ratio 1.65), than first generation students. Minority status was not a significant contributor to the model.

Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict four-year graduation rates. The assumptions of observations being independent and independent variables being linearly related to the log were checked and met. The model predicted 16% of the variance (Nagelkerke Squared=0.159). The Chi-Square=137.34 (2), $p<0.001$. This is like a R=0.4 or a medium to large effect size Cohen's (1988). In this model the primary contributor to the equation was minority status. Non-minority students were 1.78 (Odds ratio 1.784) times more likely to graduate in four years than were minority students.

The last Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict six-year graduation rates. The assumptions of observations being independent and independent variables being linearly related to the log were checked and met. After multiple iterations of Logistic Regression, the best predictive model accounted for 12% of the variance or in other words, our ability to predict graduation rates was increased by 12% from the zero-order model (Nagelkerke $R^2=0.12$). This is equivalent to Cohen's r effect size of R=0.33 which is considered a typical or medium effect size (Morgan et al., 2013). The model that predicted the best included minority status, residency and first generation status. Although other predictors were significant alone, when all variables were placed into the model collinear effects of gender and Pell eligible fell out and minority status, residency and first generation status were the best predictors of six-year graduation rate.

Discussion

The purpose of this study was to thoroughly examine demographics at one land-grant institution from 1990-2014 to guide future program investment. This examination was conducted through three separate yet related segments. Whether through pie charts or Chi Square Goodness of Fit, the first segment of this analysis clearly demonstrates that this CAS is not currently representative of the ethnic demographics of the state it serves. In fact, it's representation of Hispanic/Latino students has decreased from 1990-2010. This begs the question of whether the CAS is meeting its land grant mission when it so clearly does not represent the state. Given the significance of the differences found in 1990, 2000 and 2010 for CAS Hispanic/Latino and African American undergraduate under-representation this is an area that has great recruitment potential. The recruitment model previously published in the NACTA Journal may serve as a model for recruitment efforts and future study (Talbert et al., 1997).

The second segment of this study shed light on many opportunity gaps for undergraduate students entering the university through 1990-2014. Male students had significantly lower first year GPAs and final/current GPAs and four-year graduation rates than female students. The practical significance of the GPA differences could be argued but it does indicate an area of investigation as to why male students have lower GPAs. Further investigation could also look at if there is a difference in first year salary or admission into graduate school for male students given their lower GPAs as there may be no practical implication to the lower GPAs. The difference in four-year graduate rates found here indicates that support for male students to graduate sooner is warranted. Pell eligible students had significantly lower first year GPAs and final/current GPAs than non-Pell eligible students; Pell eligible students also had significantly lower retention to second year rates, four-year graduation rates and six-year graduation rates than non-Pell eligible students. Once again, the practical significance of the lower GPA can be argued. However, the academic and financial effects of the differences in retention to the second year as well as four and six-year graduation rates for Pell eligible students clearly indicates that they need more support. The opportunity gap analysis also indicates that there is a significant need for more support and programming targeted at first generation students. First generation students had significantly lower first year and final/current GPAs. First generation students also were significantly less likely to be retained to the second year and they had significantly lower six-year graduation rates. Even the four-year graduation rate warrants scrutiny as the chi-square statistic is close to significant at $p=0.032$ indicating an opportunity gap in every area studied for first generation students. Resident students are being significantly outperformed by non–residents in terms of first year GPA. However, residents are significantly more likely to be retained to the second year and they have significantly higher six-year graduation rates. There are also a number of statistically significant opportunity gaps for minority students studying in the CAS. Minority students had significantly lower first year GPAs and final/current GPAs. Minority students also had a significantly lower four-year graduation rate and a lower six-year graduation rate than majority students.

These differences indicate that there is a need for more support and programming for minority students as well.

The third segment was targeted at current trends within the CAS. As such, this segment of the study was focused on the cohorts of undergraduate students entering in the fall semesters of 2003 through 2008 in three separate step wise logistic regression models to assess whether the predictor variables of gender, ethnicity (minority/majority), residency status, Pell eligibility and first generation status are significant predictors for retention to second year, four-year graduation and six-year graduation. The evidence found in the model for first-year retention gives a modest amount of support targeted at first generation students; this finding was further supported by the opportunity gap evidence found in segment two of the investigation. However, the logistic regression models did show predictive value for some of our variables for four and six-year graduation rates. Of note, non-minority students were found to be 1.78 times more likely to graduate in four years than were minority students with minority status being the primary contributor to the model. In the final investigated model, the strongest predictor of six-year graduation rate was minority/majority status. Minority students were 53% less likely to graduate then majority students in six years. First generation students were less likely than non-first generation students to graduate in six years and non-residents were more likely to graduate than residents of the state within the six-year time frame.

At least at this College of Agricultural Science, this rigorous analysis of undergraduate data does not support the notion that the College is achieving the land grant Mission. The CAS is not representative of the state population. Additionally, in the historical analysis, numerous differences were found in student success indicators such as retention to the second year, first year GPA, final/current GPA, four-year graduation rates and six-year graduation rates. Furthermore, in the analysis of current opportunity gaps, gender, Pell-eligibility, minority status, first generation status and residency all played a significant role in predicting some level of student success. These findings provide further evidence that this College of Agricultural Sciences is not successful in achieving its mission. Idealistic mission aside, this investigation is clear in its findings that with the changing demographics of the United States, it will be difficult to educate sufficient numbers of professional agriculturalists if the current student success gaps are not addressed. The purpose of this study was to thoroughly examine agricultural higher education demographics at one land-grant institution from 1990-2014 to guide future program investment. Future research can employ this approach at other land grant institutions. In so doing, agricultural educators could benchmark and set growth goals for both recruitment and retention.

Summary

In 2009, Slaughter told those reading the Chronicle of Higher Education that it was “time to get angry about underserved students” (Slaughter, 2009, p. A68). Slaughter argued that the lack of attention to underserved populations like Hispanics and African-Americans threatened United States preeminence in higher education. While the need for anger can be argued, based on the findings of this study, the need for more investment in programming for Pell-eligible, first generation and minority students is clear.

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A KENTUCKY STUDY

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The Role of Experiential Education: An Analysis from Students' Perspective

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Introduction

Demographic backgrounds of students majoring in Colleges of Agriculture are changing. With more enrollment coming from urban areas, students have little or no personal experience with farming or other agricultural industries. Faculty and employers register a growing concern about a graduate's preparation to assume positions in agriculturally-related firms. As the jobmarket becomes more competitive, graduates are finding that good grades are not enough to help them land their first post-graduate job. As a result, experiential education is becoming important as an aspect of undergraduate education to meet a changing employment situation.

Experiential education is a generic term which describes a wide variety of learning situations (e.g. field placement, internship, work-study) outside the classroom. Students may or may not receive academic credit, they may or may not earn money for their activities during their placements, and they may or may not be required to do this type of activity as part of their graduation requirements. What does link all these disparate experiences is that: "Students in experiential education programs take on new experiences featuring significant tasks with real outcomes and concrete learning achievements" (Harris et al., 1989:7). Although experiential education can be viewed as a modern version of the apprenticeship of the Middle Ages, in contemporary higher education it has not always met with wide acceptance.

Indeed, within higher education, experiential education has often been a controversial issue. A review of the arguments for and against including such activities in the modern curriculum could begin with John Dewey. In *Experience and Education* (1938), Dewey argues that the complexity of modern society demands a balance between abstract or formal learning and opportunities to test this knowledge in real life situations. In field placements, formal learning becomes real and the theories, concepts and methods of the classroom can be tested in practical ways. Chickering (1976:62) also suggests that experiential education can increase a student's motivation for and commitment to continued learning. The field placement can highlight gaps in a student's learning, but there also is a special excitement that comes from "seeing knowledge and skills effectively applied." Tumin (1976:48) notes another advantage in "that many important things are not learned well in traditional schools and...that many important things are not learned at all." Tumin goes on to describe some of those things that typically are not learned in the classroom. These would include interpersonal skills such as working in groups or with persons who are different, leadership skills and, self-confidence. A final advantage offered by experiential education revolves around its contribution to a student's vocational decisions. In field placements, students can "try on" a career by personally experiencing the work environment.

Are the "problems" supposedly associated with experiential education "real" or only a reflection of the fact that it occurs outside the traditional definitions of academic learning and so challenges us to think about higher education in different ways? Are the opportunities to learn those things that often are not learned at all within a traditional academic environment as important as those things that are typically associated with the classroom setting? Do the benefits of experiential education outweigh its perceived costs? How do students who participate in field placements evaluate these experiences? The following attempts to provide information to answer these questions using the results of a survey of current students and graduates of the University of Kentucky College of Agriculture.

The Survey and the Sample

In the summer of 1989, mail surveys were sent to currently enrolled students and recent graduates of the College of Agriculture, University of Kentucky who had been enrolled in an experiential education course or whose advisors indicated that they had participated in a field placement. The survey process yielded a response rate of 56.5% for students and 51% for graduates.

The surveys obtained information on the nature of the experiential education placement, the respondents' views on the skills and knowledge developed during these placements and their general attitudes toward experiential education. Recent graduates also were asked to consider how participating in experiential education affected their employment after graduation.

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Participation in Experiential Education

Over half of the current students and graduates report agricultural economics as their major with landscape architecture and agronomy representing the other significant groups of disciplinary majors. The majority of the students did their experiential education activity in the summer between their junior and senior year. Besides these similarities in academic major and timing of their placements, there are important similarities in their personal backgrounds. For more than two thirds of the participants, both their mothers and fathers either worked full-time or were self-employed. The vast majority of their parents had completed high school and a substantial number also had some college. But over half did not come from a farm background. Hence, many of the participants would benefit from the opportunity to gain experience with agricultural-related firms. Moreover, the students who participate in experiential education tend to come for families with a strong work ethic and a high educational attainment which may account for their interest in and willingness to explore field placement.

This is somewhat substantiated when we examine why students participate in experiential education. Less than one in three of the current students and one in four of the graduates indicated that it was a requirement of their degree program, and therefore in this sense, the participants were not "forced" into a field placement but chose this option of their own accord. This is not to say that they did not receive some compensation for their participation. While graduates were twice as likely as current students (69.7% vs 35.9%) to indicate that they had received academic credit for their placement, the vast majority of both groups had received some pay for their work, with the current students averaging $724 a month and the graduates $666 a month.

Nature of Field Placements

Field placements occur in a wide variety of firms and settings. Students worked in agribusiness firms (e.g., farm supply cooperatives, landscape architecture firms, greenhouses, financial firms, grocery stores), in county extension offices and as research assistants to faculty doing laboratory or field experiments. Given the diversity of placements, it is not unexpected to find that the duties performed also varied widely. During their field placements students assisted extension agents, store managers and researchers in their various work roles; had responsibility for organizing fund-raising activities or coordinating media programs; developed and analyzed financial and other types of data; performed design work for architectural and landscape firms; and some simply did general field or clerical labor. Clearly, there are major differences in the levels of responsibility and the scope of the duties students performed and it is likely that these differences are a factor in how students evaluate the educational value of their placement. However, this could not be explored further given the small sample size.

Eight out of ten of the current students indicated that the firm where they did their field placement was the type of firm for which they wanted to work upon graduation. A comparable number of graduates indicated that their field work provided them with an edge in searching for a job. Indeed, one out of five have been or are currently employed by the same firm where they did their field placement and one out of four are working for a related firm. These graduates believed that potential employers viewed them more positively and two out of three also felt that their field experience helped them to advance in their own chosen career.

How did the field placement experience affect the participants? Both current students and graduates were asked to indicate the extent to which their field work had contributed to the development of a list of skills and abilities and then to indicate their level of agreement with a series of statements about experiential education. The following analysis compares and contrasts the views of current students and graduates as to the influences of their experiential education activities. Individual comments will be used to illustrate particular points.

Field Placements and Skills

Overall, current students were very enthusiastic about their experiential education program (Table 1). Half or more stated that the field placement helped them to work independently and effectively with others, even those from different backgrounds. A similar proportion also stated that they learned how to listen effectively; how to identify, define and assign priorities; how to conduct research projects; how to apply the basic concepts of their disciplines; and, how to develop their own ideas and program of work. Finally, six in ten indicated that the field placement helped them feel more confident about their major and choice of a future career. It is interesting to note that nearly one in three of the current students also indicated that their field placement led them to use a microcomputer for both word processing and data analysis or spreadsheet work. Given the wide diversity of field placements it is remarkable that so many students would be using a computer during their placements. In general, the skills checklist suggests that field placements help students to gain a better understanding of the role of agriculture in society and provides them with a better understanding of the work world they are preparing to enter.

The graduates generally agreed with the positive assessments of the current students on the contributions of experiential education to their academic skills and personal abilities, although not to same the degree. As with the current students, graduates overwhelmingly agreed that during their field placement they learned how to work effectively with others from different backgrounds or with different views. Half or more also indicated that their placements had somewhat to a great deal helped them learn how to speak and write effectively; read with understanding; organize and lead others; identify, define and assign priorities; conduct a research project; feel positive about their academic major and career choice; and, understand better the relationship between agriculture and the larger society.

Several respondents offered personal comments to illustrate their responses to the checklist and two of these high-

Table 1. Experimental Education Skills and Abilities
Below are listed some skills and abilities that a person might acquire when doing field work. The percentages indicate the degree to which respondents felt that their placements helped them to acquire these skills.

		A Great Deal %	Somewhat %	A Liule %	Not At All %
Speak persuasively	Students	33*	41	21	5
	Graduates	17	45	22	16
Write effectively	Stu	21	36	28	15
	Grad	15	35	25	25
Write for different	Stu	21	23	26	31
kinds of audience	Grad	16	22	27	35
Listen effectively	Stu	62*	38	--	--
	Grad	38	49	9	4
Read with understanding	Stu	33	36	26	5
	Grad	22	43	22	13
Work effectively with others	Stu	80	18	2	--
	Grad	75	18	3	4
Work with others who hold	Stu	67	21	10	2
different views or are	Grad	62	29	8	1
from different backgrounds					
Organize and lead others	Stu	33	31	23	13
	Grad	22	43	20	16
Work independently	Stu	69*	31	--	--
on your own	Grad	56	34	6	4
Develop your own ideas and	Stu	54	28	15	3
program of work	Grad	36	39	16	9
Have self-confidence	Stu	61*	31	8	--
	Grad	45	38	12	5
Feel positive about your	Stu	59*	28	13	--
choice of a major	Grad	38	38	16	8
Feel positive about your	Stu	54	36	10	--
choice of a	Grad	44	32	18	5
Identify, define and assign	Stu	59*	26	15	--
priorities to problems/goals	Grad	27	43	25	5
Conduct a research project	Stu	56*	23	10	10
to gather data	Grad	38	29	12	22
Utilize research data to	Stu	41*	36	13	10
solve problems	Grad	29	26	22	23
Apply the basic concepts	Stu	51*	41	8	--
of your discipline	Grad	35	47	12	6
Apply the basic methods/skills	Stu	49	38	13	--
of your discipline to work	Grad	38	43	13	6
Deal with problems using	Stu	23*	33	26	18
math or statistics	Grad	14	18	35	33
Use a computer for work	Stu	31*	20	28	21
processing activities	Grad	13	13	17	57
Use a microcomputer for data	Stu	31*	8	31	31
analysis or spreadsheet work	Grad	7	9	17	67
Understand the relationship	Stu	49	26	15	10
between agriculture and	Grad	31	31	20	18
and larger environment					

*T-Test of differences in group means for current students and graduates significant at .05

light the specific ways in which field placements enhance classroom learning. "I think field work as a requirement to graduate would benefit every student. It gives a student realistic career goals and exposes some myths they believe about the working environment. It requires and builds good organization and communication used in a professional setting." "I strongly encourage and recommend experiential education at an early stage. It helps a great deal in deciding if the chosen major is in fact the area in which you wish to work. Also, it greatly improves your ability to relate to topics taught in class."

However, graduates and current students did offer somewhat different opinions on their field placements, albeit often only in degree rather than in kind. Some of these differences can be accounted for by the changing times and technology. For example, the differences in the use of computers during their placement can be understood by simply noting the increasing use of computers in almost every facet of business and education in just the last five years. Also, the graduates' views may differ because they are now employed and time has given a different perspective to their experiences. While graduates are comparing their field placements to "real life," the students are comparing to their classroom experiences.

General Attitudes

In addition to asking the students and graduates whether the field placement enhanced their academic learning, they were also asked to indicate their level of agreement with a series of statements about the experiential education process in general. Students and graduates shared some common opinions but also differed (Table 2).

Both students and graduates gave overwhelming endorsement of the fact that field work helps you learn how to cope with authority, discipline and conflict in work relationships; helps you to understand the importance of the general principles and concepts in your field; and, helps you to acquire a sense of professional identity. As one graduate commented: "I don't feel a person can fully understand their field without an additional work experience. It is very important in showing a person the good and bad areas of their major." Another said: "This has been the best three months education that I have ever had. I would recommend anyone to obtain an internship with the career pertaining to their degree. The reason being is that there are so many things that a person can learn by doing that no classroom or book can teach." The role of experiential education in introducing participants to the dynamics of the work place, the expectations of a career area and thus, helping to solidify career decisions seems unequivocal. Moreover, as the comments suggest, these are lessons that can only be learned outside the classroom where decisions and actions have real consequences.

However, this is not to say that the students and graduates did not see some problems in the experiential education process. Nearly a third of both groups felt that in field work, students often simply do clerical or manual labor and, one in 10 of the students and one in five of the graduates felt that students are often treated as "cheap labor" in a field placement. This situation may develop because of a failure to match student needs and interests with the opportunities offered by different types of firms. This suggests that whoever has responsibility for assisting students in identifying and locating potential placements have a good knowledge of how firms integrate student interns into their operation.

The issue of supervision is one of the greatest problems associated with experiential education noted both by its advocates and critics. This is particularly problematic if the experiential education will receive academic credit. At UK, there has been a gradual movement to require a written

contract between the student and the faculty member directing the experience which specifies the activities that the student will perform and the outcomes that will be used as part of the evaluation of the student's work. When placements are to be nonacademic settings, the individual with whom the student will be working is also expected to sign the learning contract, thus acknowledging both the tasks and the outcomes from the placement. Yet, despite the requirement of written contracts, they may not always be developed, and this can cause problems.

Both groups generally felt that there was adequate supervision by faculty of their work. However, one in five graduates but less than one in 20 students stated that there was not enough supervision by the firm. This is somewhat surprising since all of the firms responding to our survey indicated that one person on their staff is responsible for directing and coordinating their field placement program. It may well be that student and faculty definitions of "supervision" differ from the expectations of the firm representatives. It should also be noted that four out of the ten responding firms indicated that participating in experiential education programs requires "a lot" of additional work for them.

Perhaps more disturbing is the fact that one in four students and more than two out of five graduates stated that the criteria for evaluating their work while in the field was unclear. There are several possible explanations for this common critique. Perhaps learning contracts are not being used by all supervising faculty or, the contracts are not specific enough when addressing evaluation criteria or, there is slippage between written evaluation criteria and what is actually reviewed and considered by faculty when assigning a final grade. In the final analysis, what is clear is that the supervision of field placements and the evaluation of student performance remain problematic.

Although students and graduates agree that experiential education should be a requirement for graduation, albeit to differing degrees, they do not agree on when the field placement should occur. While one in three current students agreed that it should be in the freshman or sophomore years, only one in five graduates feel it should be at this time. It should be remembered that currently, most students do their experiential education in the summer between their junior and senior years. Although an experiential education opportunity earlier in their academic training may help students better understand career opportunities, they may not yet have taken sufficient course work in their major to fully appreciate the relationships between disciplinary concepts and methods and the work world. Moreover, freshmen and sophomores may not be as attractive as juniors or seniors to potential cooperating firms. This latter point is confirmed by the responding firms who overwhelmingly indicated that they preferred to work with juniors or seniors.

Both students (80%) and graduates (64%) supported the idea of the College establishing an international field placement program, and the majority of both groups would (or would have) participated in such a program. Given the multinational character of most businesses today, an international experiential education opportunity would probably attract considerable interest.

Table 2. View on Experiential Education

The following are some statements about field work in general. The percentages indicate the extent to which respondents agreed or disagreed with statements.

		Agree %	Strongly Agree %	Not Sure %	Disagree %	Strongly Disagree %
Field work helps you to learn how to cope with authority, discipline and conflict in work relationships	Students	49	43	8	--	--
	Graduates	42	5	1	--	--
Field work helps you to acquire a sense of professional identity	Students	39	61	--	--	--
	Graduates	34	57	9	--	--
There is little relationship between academic or course work and field work in a firm	Students	3	8	18	41	31
	Graduates	3	16	6	52	23
There is not enough supervision by faculty of student's work while in the field	Students	3	8	23	49	18
	Graduates	4	9	32	42	13
Field placements should occur within the freshman or sophomore years	Students	13	21	26	28	13
	Graduates	7	12	29	36	17
There is not enough supervision by the firm of the student's work while in the field	Students	--*	4	21	49	26
	Graduates	8	12	22	44	14
The criteria for evaluating student's work while in the field is unclear	Students	3*	23	21	46	8
	Graduates	8	36	25	26	5
Field work helps you to understand the importance of the general principles and concepts in your	Students	31	62	4	3	3
	Graduates	29	57	10	1	3
In field work, students are treated as cheap labor	Students	5	5	18	44	28
	Graduates	4	16	14	50	16
In field work, students often simply do clerical or manual labor	Students	3	26	8	49	15
	Graduates	6	25	16	39	14
All students should be required to spend one semester in a field placement as part of their academic program	Students	15	54	10	21	3
	Graduates	31	29	16	23	1
The College of Agriculture should establish an international field placement program	Students	31	49	21	--	--
	Graduates	29	35	32	3	1
I would be interested in participating in overseas field placement	Students	24	37	24	13	3
	Graduates	32	27	13	20	8

*T-Test of differences in group means for current students and graduates significant at .05.

Career Opportunities

What effect, if any, does experiential education have on graduates' job opportunities and later career progress? According to the graduates, a very beneficial effect. Graduates were asked to complete a section on their employment since leaving UK. Nearly half reported that they had a firm job offer prior to graduation and for the rest, they averaged 4 months following graduation to search for and begin a job. The great majority stated that their field work experience had given them an edge in searching for a job and that potential employers viewed them more positively because they had this experience. As noted earlier, one out of five of the graduates have been or are currently employed by the same firm where they had done their field placement, and another one quarter have been or are employed by a similar firm.

The graduates offered many comments on their competitive advantage in the marketplace due to their experiential education activity. One said: "I really think the internship that I had made a positive impact on my ability to find a job." Another noted that "Employers are reluctant to hire someone with a degree but no hands-on experience. I found my internship has opened doors for me in my career." The experience also gives them an edge once they begin their job, especially if it is in the same firm or one similar to where they had their field placement.

The suggestion that employers look more favorably on job applicants is confirmed by the responses of the firm representatives. Eight out of ten stated they give preference to job candidates who have held placements with them in the past. The other two noted that their firms look for prospective employees with field work experience.

Summary and Conclusions

This study of currently enrolled students and graduates of the University of Kentucky College of Agriculture who have participated in experiential education programs indicates overwhelmingly positive views. Students and graduates indicate that field placements help them to confirm their commitment to their discipline and assist them in career planning. The placements also clearly help participants develop and hone a variety of academic and professional skills that would not be possible with only classroom work. Furthermore, the graduates and the participating firms strongly acknowledge the value of experiential education in helping students find employment and in advancing their careers.

Given these very strong endorsements from the students who have participated in experiential education and the employers who sponsor such placements, why is it that experiential education has not become a more integral part of the undergraduate curriculum? Indeed, such experience gives students the competitive advantage in the job market. It is not just a perceived advantage but one confirmed by the businesses who hire graduates. While adequate supervision of students in placements and evaluation criteria remain problems, they certainly could not be classified as insurmountable obstacles given the significant number of participants and firms who report satisfaction on both these counts.

This suggests that the answer is to be found in our own attitudes toward learning experiences that occur outside the classroom and how we value "real life" versus "book" learning and our own willingness to engage in learning activities beyond the traditional lecture-classroom exam format. It is somewhat disheartening to realize that in the last decade of the twentieth century we are still arguing about the benefits and advantages of a learning experience strongly advocated a half a century ago.

While educators' resistance to innovations has often been remarked upon, it would seem that certain socioeconomic and demographic trends would add overwhelming weight to the reasons for including experiential education as a requirement in our undergraduate programs. For example, fewer of our students come from rural backgrounds and therefore, fewer are familiar with farming and the agribusiness industry in general. Moreover, there are fewer students entering college as the "baby-bust" generation moves into late adolescence. Academic programs that offer potential students innovative learning experiences that clearly have academic and career advantages will, in all likelihood, be more successful in attracting students than those that remain with more traditional approaches.

The results of this study support John Dewey's challenge to educators to acknowledge that learning is a multidimensional process. Harris et al (1989:10) argue: "An effective learning experience should not only include abstract principles but also provide an opportunity to test out concepts. Experiential education provides students opportunities to apply, integrate, and evaluate a body of knowledge of a discipline via firsthand participation. It lets students see real consequences of their actions and evaluate their learning by criteria other than grades."

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Building Capacity for Cooperation

Cooperative learning is a successful teaching strategy in which small teams use a variety of learning activities to improve their understanding of a subject. Each member of a team is responsible not only for learning what is taught but also for helping teammates learn. Working together in teams and learning cooperatively helps students to capitalize on one another's knowledge, skills, and resources. Five essential elements have been identified as critical components of successful cooperative learning: 1) positive interdependence; 2) individual accountability; 3) promotive interaction; 4) small group skills; and 5) group processing.

Positive interdependence is defined as linking learners together so one cannot succeed unless all group members succeed. Group members must know that they sink or swim together. Individual accountability is created by assessing the work of each individual and through peer assessment of individual contributions to the group effort. Promotive interactions involve group members teaching, encouraging, and questioning each other in a collegial manner. Small group skills involve active listening, sharing resources, and showing mutual respect and appreciation. Group processing is actuated by determining which member actions were helpful and which should be changed.

Cooperative learning has been studied in formal and informal educational and organizational settings around the world and has been found to be an effective means for improving: higher-level reasoning, knowledge transfer, knowledge retention, persistence to succeed, networking relationships and social support. Cooperative learning is also an effective means of building an appreciation for the strengths individuals bring to learning and organizational contexts. Cooperative learning methods have also been utilized to reduce intergroup conflict and build interpersonal bridges that tend to reduce prejudice and negative stereotyping (Aronson and Patnoe, 2011). In effect, cooperative learning opportunities create a scaffolding which guides learners' construction of an improved capacity for substantive cooperation.

Table 1 illustrates several practical ways to utilize cooperative learning strategies. When implementing cooperative learning strategies start small and build a culture of cooperation. Teach learners about the five essential elements of cooperative learning and how they can be successful as teams. Cooperative teams should be arranged by the instructor and be composed of three to four individuals. Assignments and tasks should be challenging enough to necessitate that individuals cooperate with their team members in order to be successful. Further time should be given for cooperative groups to debrief amongst themselves and with the instructor. Utilization of both team and individual level assessments will lead to an increase in both individual and shared group accountabilities.

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Table 1. A listing of example practical cooperative learning strategies

Strategy	Explanation	Works best for	Benefits
Jig-Saw	Each member of a cooperative group researches one part of a complex question or content area. They then compare their information with learners from other groups assigned to the same question or content. After comparing and learning in their expert group, the members go back to their original group to share what they have learned.	Content with three to four parts or facets.	Student gain content knowledge; research skills; presentation skills
Applied Problem	Within cooperative group all members work to consider a problem or given challenge; team members work to identify all known data; team members identify unknown factors/elements. Identifying various important variables and strategies assessment of the data / information and individual learner outcomes.	Applying knowledge/ skills to problems that require teams to analyze and evaluate.	Practice of applied problem and development of problem solving strategies and skills.
Structured Paraphrasing	Each person chooses content/ skills to share with others on their team. Each team member spends 3-4 minutes sharing their knowledge/ ideas. While the other team members are actively listening. The cooperative team then paraphrases what was shared making sure to correct any misunderstandings or mistakes.	To practice using content knowledge and vocabulary to clarify content/ skill understandings	Paraphrasing helps to ensure that team members are understanding content/ skills and that everyone has a chance to be heard
Flash Cards	Cooperative teams create content or skill development flashcards; team members test each other with the flashcards they made, making sure that terms can be used in appropriate ways and contexts.	To learn content in a supportive atmosphere	Helps learners memorize terminology and utilize
Peer Editing	Team members read the written responses of each of their teammates. Team members take notes on the written response (looking for errors and content omissions). Each team members paper is rated and given suggestions for improvement using a rubric; students are then allowed to edit their writing assignment.	Short writing assignments; assignments that will build towards a larger more sophisticated assignment	Team members review content while checking for errors; correcting errors requires higher level of cognitive processing; practicing how to present a case

Lessons Learned from Teaching Large Classes

Introduction

Teaching large classes can be intimidating, especially for new faculty who may have never taught before. This teaching tip is presented by two faculties in the Department of Agricultural and Applied Economics (AAEC) at Virginia Tech (VT). Both Marchant, a Professor who has taught classes since 1989, and Morgan, an Assistant Professor who is new to academic classroom teaching, are graduates from VT's Center for Instructional Development and Educational Research (CIDER) year-long certificate programs—large class and new faculty-- (http://www.cider.vt.edu/development/). Both teach large AAEC classes, which include students from a variety of majors. Thus, key challenges include teaching logistics for large student numbers, as well as maintaining student interest in course content for non-majors. This teaching tip highlights key lessons learned through these CIDER teaching certificate programs and their own classroom experiences—both general lessons on course design, lesson plans, evaluation and student engagement, as well as specific large class management strategies. The overall goal is to provide teaching tips that readers can immediately use in their large classes.

Procedures

Examples of lessons learned include the following, many of which can be applied to any class size:

General Lessons:

- To take a systematic, strategic approach to teaching. All items should align and be connected: the purpose of the course, learning outcomes and objectives, lesson plans, and assessment. *"Instructional Design involves systematically planning, developing, evaluating, and managing the instructional process, based on principles of learning and instruction"* (Doolittle, 2015c). For example, each step should build upon one another: the purpose of the course directly relates to learning outcomes and course objectives, which feed into developing lesson plans and ultimately assessment.
- Evaluate based on what the instructor wants students to learn and align with specific course learning objectives. Evaluations should place the greatest weight on the most important learning objectives. Grading should be based on student performance demonstrating knowledge of these learning objectives. The main function of assessment is to improve students' learning (Doolittle, 2015c). However, improved instructor awareness of the individual students' goals for final course grades provides additional motivation for concise communication of course assessments and associated grade weights at the beginning of the term.
- Student engagement amplifies student learning. Learning is based on the ability of students to process course material, e.g., in-class "think-share-pair" or out-of-class group projects (Doolittle, 2013a and 2013b). Group projects that include class presentations/papers or executive summaries serve to meet the skills employers want graduates to possess—team work and communication skills (Crawford, et al. 2011).
- "The single most important variable in promoting long-term retention and transfer is 'practice at retrieval' (Halpern and Hakel, 2003)."
- Break up the class session into segments. Use active learning activities during class to reinforce lecture. Employ different physical senses—think/listen/physical movement (Doolittle, 2015a; Halpern and Hakel, 2003; Heppner, 2007). Audience response systems (ARS), or "clickers" are an increasingly popular tool used to deliver curricula and educational content across diverse, heterogeneous audiences while providing instant data on learner understanding. Using ARS data during a lecture provides the instructors with the opportunity to encourage guided discussions based on "teachable moments" while minimizing the risk of "tangent" or "off-topic" discussions which tend to plague larger audiences and disrupt workshop timetables. (Morgan and Maples, 2015).
- Include activities to create a "sense of community," ownership and accountability, particularly for large classes. Examples include learning students' names, developing a rapport with students, being responsive to student e-mail, talking with students before and after class, out-of-class review sessions and demonstrating support for students (Doolittle, 2015b; Marchant, 2014 and 2007).

Specific Class Management Lessons:

- Always begin class with an engaging and enlightening example that is related to covered material
- Clearly describe course objectives and schedule of assignments listed in the syllabus that do not change throughout the course
- Do not offer extra credit or participation points
- Use a point system for grades (e.g., 1000 total points) so students know their scores throughout the semester
- Choose graded assignments that motivate students to review their notes and readings
- Restrict the use of laptops and/or electronics devices in class. Consider creating an "electronic zone" in the back of the room to avoid distracting neighboring students
- Implement a peer review evaluation system for group projects that affect individual student grades.
- Provide partial class handouts posted prior to class and completed during lecture. This frees up time for more in-class discussion and encourages attendance

Assessment

By implementing the above strategies, impacts included integrated courses—where assessments were linked to course learning outcomes and weights reflected topic importance; increased student engagement, through in-class exercises as well as out-of-class group projects; and ultimately, enhanced student learning through activities that are designed for students to research and process information that reinforce class concepts.

In closing, please allow us to promote Virginia Tech's teaching conferences sponsored by the Center for Instructional Development and Educational Research: a general teaching conference typically in early February and a large class conference in July (http://www.cider.vt.edu/). We would love to have you attend.

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The Need for A Critical Pedagogy of Agriculture

Introduction

Many of our agricultural science students can talk about why agriculture is important. They may discuss the need to feed the world, support regional and national economies, or the cultural importance of agriculture. Some students might understand the ecological implications of agricultural, such as issues with tillage, compaction, soil microbial life and even biodiversity. Yet, when asked how agriculture can improve impoverished communities or be used to enhance ecosystem services, many students are unsure.

Our agriculture students must understand the connections between agriculture and key social, economic, and ecological issues such as food deserts, rural poverty, health epidemics (i.e., obesity and type II diabetes), desertification, eutrophication and climate change. Moreover, students need to be aware of how various community educational programs and alternative agricultural practices can help alleviate some of these problems. Our students should learn about and participate in agrifood-related initiatives such as community-supported agriculture, farm to cafeteria programs, gleaning (donating unsold produce), game meat donation, urban and vertical farming and wild edible community harvesting. They need to know about food based social service programs (i.e., Food Not Bombs and Meals on Wheels), horticultural and equine therapy, food mapping, food hubs and food justice movement activities. Using our Critical Pedagogy of Agriculture (CPAg) framework can bridge this knowledge gap and help guide College of Agriculture educators in their practice.

What is a Critical Pedagogy of Agriculture?

Similar to other critical pedagogies, CPAg is a way of thinking about, questioning, negotiating, and acting to transform our understanding of knowledge, institutional structures, and relationships surrounding the agriculture-society nexus. CPAg focuses on improving social and ecological issues through agriculture. The first step is to ensure that alternative agricultural paradigms and systems are covered in the college classroom. This opens dialogue about the implications of different agricultural practices (i.e., conventional farming, concentrated animal feeding operations, permaculture and agroecology). We recognize that educators may not be

able to address all of these issues and alternative practices, yet given the applied nature and range of topics within the discipline, CPAg is relevant to most agricultural courses.

Procedures: How to incorporate CPAg

This section provides a brief overview and guiding discussion questions for three key agricultural issues.

1. Building Community-Based Food Systems

Ensuring access to healthy food is a daunting problem. Those most in need may not know how to grow food or have access to land. Colleges of agriculture are not immune to these food justice issues as land-grant institutions were originally founded to improve and share agricultural knowledge. CPAg argues that part of the solution is for people to become active participants in their local food system. Questions to be posed:

a. Who has the right to call themselves a farmer or gardener?
b. What is the economic impact of backyard gardening on the agrifood industry?
c. What role can urban and suburban gardening play in alleviating food deserts?

2. Addressing Social Inequality

There are a variety of connections between agriculture and inequality. Many agricultural workers in America live at or beyond the poverty line. Migrants exist in the shadows of our agricultural industrial complex, harvesting, processing, and serving the food we eat. CPAg pushes students to increase their awareness of the rights and wages of agricultural workers and to consider how the economic structure of family farming is changing. Students should consider the following questions:

a. What is the relationship between immigration policies and agricultural labor?
b. How have changes in family farming impacted rural communities in the past 50 years?
c. Should agricultural labors be paid more to encourage future farm ownership?

Students in agricultural science-based classes need to consider these questions and the social injustices in our agrifood system by becoming a part of assigned community service projects that provide experiential education.

3. Contested Agricultural Approaches

Agriculturalists can be divided into two broad ideological camps: conventional (i.e. tillage, synthetic inputs, and the use of genetically modified seeds) and alternative (i.e., no-till, agroecology, and permaculture). This divide is visible in colleges of agriculture when considering diverse student populations and their associated agricultural values. This divide has led to legislative battles between stakeholders and businesses and has shaped the Farm Bill and other USDA policies. Professors need to be inclusive of diverse agricultural values and alternative approaches, even if they do not agree with them. Questions:

a. What is your experience with conventional and alternative approaches to farming?
b. What are the costs and benefits of using synthetic agricultural chemicals?
c. What are the social and ecological costs and benefits of annual agriculture (i.e. corn, soy, wheat, etc.) vs. perennial agriculture (i.e. orchards and tree crops)?

Assessment: How CPAg Changes Conversations

Students often come to see the complexities and deeper issues of the agrifood-society nexus using these kinds of critical, problem-posing questions. The outcomes from these activities range from critical awareness of one's food sources to planning for rural community through agriculture. For example, food mapping asks students to write reflections about their experience investigating food sources. Some students develop an interest in "wild edibles" and the lack of food-worker knowledge regarding food being served in restaurants. Other students note food miles and the differences in pricing between organic and conventional produce. Another example can be found in the case study of a rural food dessert. Students were challenged to think how rural citizens can produce food locally. They struggled initially, but soon identified ways for rural community members to become active in promoting more economically sustainable food through farming, gardening, ranching and hunting.

We recognize that these critical conversations don't always happen in agricultural classes; yet, when they do, they can help students generate answers to questions about how agriculture impacts and influence other structures and outcomes in society. CPAg helps students think through these issues and make connections to their liberal arts coursework and local communities. The CPAg framework encourages students to work for positive social and ecological change through agriculture.

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Use of Movies to Teach a Leadership Lesson

Introduction

Concepts of leadership can be learned in many ways. Students benefit from diverse approaches that appeal to a variety of learning styles. One of the most successful ways that I have used to apply leadership lessons learned in the classroom is "Leadership at the Movies." I use a variety of movies to challenge students, challenging students to critically apply a wide variety of leadership lessons. Lessons can range from individual skill techniques to the application of values and character traits in effective leadership. Movies can depict leaders in formal leadership roles, such as President Kennedy in "Thirteen Days" to informal leadership roles such as Andy Dufresne in "The Shawshank Redemption."

Using movies to enhance leadership lessons offers many benefits to the learning process. First, movies appeal to a younger audience accustomed to television/digital images. Movies provide an opportunity for self-paced or online learning (it is not necessary to utilize formal class-time for movies that are accessible for home-based viewing). Movies can provide a broader or different perspective of leadership that may engage student deeper and challenge them to apply course concepts at a higher level.

Sample Movies

Apollo 13 (PG)

Jim Lovell (Tom Hanks), plays the leading character in this film about a crew of astronauts dealing with an explosion on their craft in outer-space. Lessons such as team work, communication, problem solving and dealing with chaos are evident through this film. Lovell uses calm and creative leadership to deal with a challenging situation and focus his team to use its resources to address problems and arrive safely back at Earth.

Sample Application/Discussion Questions:

1. How does Lovell establish himself as a leader of his crew?
2. How does Lovell address adversity/chaos during the flight?
3. What techniques does Lovell use to unite his team as a leader?

Shawshank Redemption (R)

Andy Dufresne is wrongly convicted of murdering his wife and sentenced to the Shawshank Prison system. Best for mature audiences, this movie is an excellent example of establishing a vision, positive thinking and fortitude. Andy perseveres and reaches personal success and challenges others along the way to seek positive outcomes and thrive against all odds.

Sample Application/Discussion Questions:

1. Andy assumes an "informal" leadership role at Shawshank Prison, how does that happen?
2. In what ways did Andy approach his stay at Shawshank differently than most other inmates?
3. What are some examples of ways that Andy had positive impacts on others through his actions or decisions as a leader?

Patch Adams (PG13)

"Patch Adams" is based on a true story, of a doctor that doesn't follow the expected protocol, nor "fits the mold" of a typical doctor. An inspiration story of a many that overcomes adversity, challenges and road blocks to success, this story combines humor and drama to teach valuable lessons. This films is useful to represent topics such as "challenging the process," "leading with heart" and "servant leadership."

Sample Application/Discussion Questions:

1. In what ways did Patch approach life/medicine differently than other medical students?
2. Why did Patch face challenges/road blocks along with way as he worked to achieve goals/make change?
3. How did Patch overcome obstacles to make change and impact others?

Amish Grace (NR)

Focused on the power of "forgiveness," this movie is also an excellent tool to highlight concepts such as cultural understanding and diversity. Based on a true story in Nickel Mines, PA, an Amish community deals with the impacts of a shooting at an Amish school house where a man fatally shoots five Amish girls before taking his own life. Miraculously the parents of those that lost children in the shooting convey a true sense of forgiveness to the perpetrator's widow and rely on their faith to move forward and accept the power of forgiveness.

Sample Application/Discussion Questions:

1. To what extent, did the Amish families deal with the shooting situation differently than how we would expect non-Amish?
2. Why do the Amish embrace forgiveness in the manner that they do?
3. How can we apply the concept of forgiveness to those serving in leadership roles?

Remember the Titans (PG)

Set in 1971 in Virginia, Herman Boone is an African-American football coach at T.C. Williams High School in their first season as a racially mixed school system and football team. Coach Boone uses a relentless positive attitude, drive and determination and role modeling to drive change in this community. Overcoming extreme resistance and challenges, Boone was able to unify the team and town to rally behind the football program. Lessons in this movie range from challenging the process and establishing a vision to overcoming adversity and prejudice, this movie is an appealing movie for many audiences and topics.

Sample Application/Discussion Questions:

1. What were the challenges and obstacles that Coach Boone faced as the new football coach at T.C. Williams High School?
2. What approaches did he use to deal with problems/ issues?
3. How was Coach Boone able to overcome challenges and unite the community behind the football program?

Conclusion

Movies can be effective instructional tools for a wide variety of leadership lessons. Entertaining visual displays along with discussion, application and interaction can make for a powerful and enjoyable learning approach. It is important to engage students in discussion or reflective writing to encourage deeper understanding of concepts and lessons.

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Cooked: A Natural History of Transformation

By Michael Pollan. 2013. The Penguin Press, New York, NY. 403 p., paper, $17.00, ISBN 978-0-14-312533-4.

Anyone who has read previous books by masterful storyteller Michael Pollan will not be disappointed with *Cooked: a Natural History of Transformation.* Using the four elemental sections of Fire, Water, Air, and Earth, the author weaves a history of the human development of processing and transforming raw materials from nature into the edible foods that we enjoy every day. The book is carefully researched and referenced, yet unlike academic texts is personal, thoughtfully written and flows more like a well-crafted novel than a non-fiction book about something as basic as cooking. Welcome to *Cooked*.

The act of cooking preserves the intricate relationship humans have with nature. Cooking detoxifies many food sources, enhances their nutrient value and provides a space for humans to share, listen and eat together. However, this intimate relationship with food has been altered in the past few decades as more U.S. consumers leave their kitchens and let food industry provide their meals. The author explores both the historical significance of our intimate relationship with food, as well as recent changes in human consumption habits that are driven by a barely-regulated food industry that puts profit ahead of human wellness, contributes to untold human costs in medical bills and unusually early deaths, and in a dismaying turn of events becomes a model for much of the developed world. We follow Pollan in his journey into the origins of food preparations through literature searches and thoughtful documentation, as well as into his kitchen where he learns first hand how we transform nature and her ingredients into digestible delicacies using the four basic elements.

This journey through the elements begins in Ayden, North Carolina where he learns the history and culture surrounding authentic barbeque, the kind that involves long hours cooking a pig in a pit room over a slow fire. It is no coincidence that as humans we enjoy the flavors and smells of barbeque. As he describes the process, *"It may well be that [some] animals are 'pre-adapted' to prefer the smells, tastes, and textures of cooked food, having evolved various sensory apparatus to steer them toward the richest sources of energy"* [p 61]. In addition to introducing us to the fabled competition among famed barbeque cooks and their curious idiosyncrasies, the author presents an unlikely myth about how the process was invented by tasting a roasted carcass pulled from a burned down barn. But rather than detract from the story, this enjoyable factoid adds to the mystique that surrounds a truly southern delicacy that has spread across this country and abroad.

Next Pollan moves to water and imagines the historical discovery of using fire and water to cook food, starting with heated stones in vessels made of animal skins before invention of pottery and metal cooking containers. He discusses the intricacies of blending vegetable and animal ingredients with proper spices to create new emergent properties of aroma and tastes in food. Integral to the story are the personalities associated with different cultural traditions and preparations, including a young friend from Iran who made weekly visits to the author's kitchen to introduce new ingredients and food preparations, along with the history of these in another country. Throughout the book we are introduced to special people who devote their lives to food and adding value to simple ingredients through cooking. The story of water and food is one part of the story of civilization.

One of the most intriguing sections of the book discusses the history of baking, with a suspected origin in the human search for a way to transform seed of grass species into something easily digestible. The author describes not only our growing capacity to process this vital food source into more edible products, but the accompanying co-evolution of enzymes in the human gut to catalyze the process. He goes on to describe the invention of white flour that began a societal norm of whole wheat bread for poor people versus white flour for those who were rich, to a flipped current behavior of white bread cheaply available to the poor while those with higher incomes and concern for nutrition now eat brown bread. Pollan documents how industry has changed wheat flour from something that was living (included the bran and germ), unpredictable, and perishable to white flour that is stable, has a longer shelf life and is not living (bran and germ removed). This is not the only time that the food industry has transformed a beautiful natural substance into one that is easily digestible with low nutrient content. The story of flour portends the emergence of a food industry intent on profits, often using the guise of nutrition as a marketing tool.

Lastly, the section on fermentation and brewing brings alive the history of this fascinating process, as told through the stories of current brewers and their artisan-like trade. Pollan discusses the paradox of our quest to create germ-free environments in our food processing, yet rely on probiotics in mothers' milk to give infants a good start on life, on microbes that help us produce cheese, yoghurt, kimchi, and beer and on penicillin from soil organisms to keep us healthy by killing the bad bugs that cause infection. It may in fact be bacteria-free food that is making us sick and cultured foods that keep our gut microbes as well as ourselves healthy and safe. Again, the story is told through visits with unique personalities who have dedicated their lives to one of these processes, providing a rich narrative of people, process, and place to illustrate this part of our food and cultural environment.

Throughout this book, the reader is challenged to answer several key questions. How has food changed us? More importantly, how have we changed food through industrialization and mechanization? What can the serious student of food do to improve personal nutrition and what can society do to reverse the general trends toward obesity, diabetes and heart disease through taking back control of our diets? There are serious messages here to the food industry as well.

Such serious questions are addressed though many personal stories, always enhanced by Michael Pollan's personal involvement with the preparations and evaluation of each product. The book reads like a novel, yet contains so many practical tidbits about cooking that one is left with hundreds of small suggestions on how to relate more effectively with our food. *Cooked* offers both a scientific and cultural interpretation of the history of *Homo sapiens* and food. The depth of research and practicality found here is revolutionary for those who have yet to read a book by Pollan. *Cooked* provides an exciting perspective on our relationship with food throughout time as well as our current intimate relationship with this critical resource. It explores topics from the evolutionary implications of cooking, baking techniques, vegetable ferments, and the human microbiome. And of overall importance is the way we have changed our relationship with food when outsourcing much of the preparation to industry, much to our own disadvantage as we lose the power of food to nourish and sustain us and transfer this power to the insensitive and even brutal commercial economy. This is a wake up call and a stimulus to actually wake up to savor the real value of food in history and in our lives and how we can choose a more healthy food future.

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Awakening Community Intelligence: CSA Farms as 21st Century Cornerstones

By Steven J. McFadden [book review]. Soul*Sparks Books, Chiron Communications, Lincoln, Nebraska. Paperback, 41 p., $9.99. ISBN 9781311507341.

Community Supported Agriculture [CSA] is a growing movement in the U.S. and elsewhere that provides both a metaphor and a model for cooperation in the future. Author Steven McFadden describes this succinctly as an activity that *"emerged as a dynamic pathway linking human beings and their communities directly in free-will association with nearby farms and the farmers who touch the earth on their behalf."* Although based on agriculture and local food production, and an opportunity for consumers to "know their farmer" and access quality products from nearby farms, the CSA is much more than a part of the food supply.

Well known to many of us, CSA represents a contractual arrangement between a farmer [or farmers] and a group of consumers who invest at the start of the growing season in a weekly allotment of food that they can pick up or that may be delivered. Thus the buyer assumes a part of the risk in each growing season; if things go well they may receive more than what they paid for, and if the year proves difficult they share the pain with their farmer supplier. Joining a CSA brings people closer to their food supply, and to their farmer, establishing a link that has been lost for most of us who shop in the supermarket and buy food that "comes from everywhere, but from a global nowhere" in the words of Prof. Jack Klopfenstein from University of Wisconsin. Although Country of Origin Labeling [COOL] on commercial food products gives us some indication of where an item comes from, it scarcely scratches the surface of a long chain that involves use of natural resources and chemicals, heavy involvement of multinational corporations, unknown impacts on the environment, inequitable distribution of economic benefits, and often untold health impacts on those who labor in the fields. CSA marketing strategies reduce many negative impacts and make much of the food system more transparent.

Author McFadden points out that in 1990 when he wrote the first of two previous books, there were 90 CSAs in the U.S. and today there are more than 12,000. This movement is not confined to our country, as there are many similar arrangements in Europe and elsewhere called box schemes or by other names. He emphasizes in Chapter 1 that joining a CSA is a move to support farms and farmers, their wellbeing and capacity to provide quality food direct to the consumer, more effective than merely "buying food from a farmer" as we find in other well-meaning schemes such as buying from a cooperative or in a farmers market. A CSA member is supporting a new type of farming system where they are involved directly with those who grow their food. With all of their successes, it appears that the weakest part of

many CSAs is true lack of "community" and that those groups with the highest level of participation and identity with the whole operation have the highest renewal rates and degree of satisfaction (Chapter 2).

Three important seeds that underlie success of CSAs were planted in Germany several decades ago, and these have only partially germinated in the emergence of today's ventures in the U.S. (Chapter 3). One is cooperative financing of the initial farm establishment, another the participation of members in helping to grow the crops, and a third the planning of adequate amounts of produce and willingness of members to invest in and consume all that is produced. The latter two have more commonly been realized in CSA arrangements in the U.S. In Chapter 4 the author distinguishes between a CSA as merely a unique marketing scheme and this strategy as more importantly building a "web of relationships" between farmer and consumers that extends to the broader community. He emphasizes the importance of mutual commitment based on trust and expressed by participation, and insists that many such arrangements transcend the obvious connections about food and provide a basis for a well-functioning human community.

Given our current culture imbedded in multiple forms of digital communication, the emergence of new forms of networks also impacts CSAs and their many iterations (Chapter 6). McFadden describes the potentials for "transparency, equity, and environmental soundness" of emerging food systems because of the facility for sharing information, and quotes Nevil Cohen as observing *"the future of agrarianism is not vertical, nor even simply horizontal; it is distributed and networked."* The author would agree with my approach in agroecology classes where I suggest that students consider our future food systems more as food webs, analogous to those in nature, rather than the commonly described food chains that are simplistic and linear.

Core groups are described in Chapter 7 as the smaller teams of key individuals who hold a successful CSA together. Although many CSAs are organized and managed by the farmer, many are closer to the "marketing schemes" described above than the true participatory and responsible communities that encourage longer-term success. Akin to a cooperative's board of directors, these prime actors provide long-term support and continuity to an operation, and go to the heart of the book's theme of building a truly community supported agriculture. One way to promote this level of involvement is transparency of a farm's fiscal operation, a strategy to build awareness of the total picture of farming costs and risks that is likely to bring better appreciation of the entire farming enterprise and lead to enhanced commitment by the shareholders (Chapter 8).

In conclusion, the author returns to the theme of developing "community intelligence" as a foundation for successful CSAs through willing participation of consumers and their commitment to joining with farmers in this unique approach to a local food system (Chapter 10). He concludes that CSAs have potential for *"meeting a triple bottom line of economics, environment, and community in qualitative ways beyond the capacity of profit-focused corporations or farms. This is community intelligence in action."* Steven McFadden's latest book is a testament to the power of people in community, and to ways this collective power can impact our future food systems.

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Agroecology: the Ecology of Sustainable Food Systems

By Stephen R. Gliessman. 2015. CRC Press, Boca Raton, Florida. Hardcover, 371 p., $79.95, ISBN 978-1-4398-9561-0.

Holistic education and research in agroecology are growing in importance in the U.S., and increasingly endorsed by FAO and other influential organizations. Emphasis has also broadened to include the entire process of food production from natural resources and purchased inputs through processing and marketing to consumption and nutrition, and will soon embrace conversion of waste to valuable resources that can cycle back into the production process. *Agroecology* is a key textbook for undergraduate education in this important field, and the new Third Edition by professor emeritus Stephen Gliessman from U.C. Santa Cruz will certainly not disappoint those already familiar with prior versions.

Our growing recognition and concern about food production and access by all to solve current nutrition challenges on a global scale has moved many of us from focus on agricultural practices and more efficient use of increasingly scarce non-renewable resources to a thoughtful study of total food systems. As stated in the foreword by Ricardo Salvador, *"life is about understanding the times in which you live and therefore what you should do with your life"* (p. ix), a concise summary of what education is all about. Dr. Gliessman challenges us to move beyond production details and put them in context within whole systems, and questions our current singular paradigm of domination of the environment. The author further urges us to consider social issues such as the need for adequate wages for farm workers, safe working conditions, and rational distribution of food and other benefits of the agricultural enterprise. This changes the educational scene, and the new edition of Gliessman's text helps in the transition.

In the first two chapters there is adequate evidence for the need for "fundamental change in agriculture" (Ch. 1), and visiting the agroecosystem concept (Ch. 2), both similar to previous editions. The rest of the book follows an appropriate hierarchical framework, with sections on plants, soil and environmental factors; the next on complexity of biological systems followed by a section

that focuses on system-level issues and especially the important interactions that make study of agroecology unique from other reductionist fields; a short section on transition from present systems to those more sustainable under changing climate and unpredictable weather; and finally a section on broad topics that deal with society, community, culture, and transformation to a long-term sustainable approach to food systems. It is this last section that clearly distinguishes the third edition from the prior two. This review will emphasize what is innovative in the last three chapters.

Dr. Gliessman expands on the sequence of steps proposed by Rod MacRae and colleagues in Canada, who suggested improving systems through 1) greater efficiency → 2) substitution of alternative practices → 3) redesign of systems by adding two new dimensions: creating local food systems through connecting farmers with consumers, and then linking these local systems on a larger scale to *"build a new global food system, based on equity, participation, and justice, that is not only sustainable but also helps restore and protect earth's life support systems"* (p. 279). The challenge is to move researchers out of their disciplinary silos to consider broader issues in the food system, and to consider ethical issues such as distribution of benefits from our research and education. There is a chapter on indicators, reporting on recent advances in "how to measure the unmeasurable" according to some critics, and now exploring soil health, crop productivity, ecological parameters, and social dimensions of development. These are all important steps forward from the previous editions of the text. Lastly, the author tackles some of the seemingly intractable challenges facing any thoughtful and concerned student of farming and food systems: issues regarding long-term food security and food sovereignty, globalization and consolidation resulting in corporate control, political processes and power relations in policy determination, and general complacency of a population of consumers that seeks the cheapest food possible without attention to who grows it, how production is managed, and who benefits from the system. A series of steps is proposed for changing the food system, and here the book clearly takes a stance on advocacy and reflects the well- known quote from Nobel laureate René Dubos, who said that "Wherever humans are involved, *trend is not destiny.*"

Readers of prior editions will recognize the comprehensive glossary, the impressive collection of references that complements those with each chapter, and an index to key terms found throughout the book. There are thought-provoking questions concluding each chapter, as well as current web sites to enable a student to access timely new information. Since the first edition of *Agroecology: Ecological Processes in Sustainable Agriculture*, this undergraduate textbook has been one of the most widely used resources in this field in U.S. universities. The third edition now titled *Agroecology: the Ecology of Sustainable Food Systems*, promises to keep that place among the many publications and web sites that are coming out in this burgeoning field. We can observe the expanded chapter on animals and crop/animal integrated systems, an improved emphasis on agroforestry but lack of attention to permaculture and perennial systems in general including potentials of prairie polycultures [there is a pull-out box on the Sunshine Farm Project from The Land Institute in Salina, Kansas], and still a preponderance of examples from California and Central America. But of course that is where the author's competence is strongest. It is commendable that Dr. Gliessman continues to access current literature and provide our students with a comprehensive and accessible text on agroecology, a book that should be the first one to consider by anyone starting up an undergraduate course in this important and growing field.

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