RESEARCH CONFERENCE PROCEEDINGS

North Central Region

American Association for Agricultural Education

Research Session Coordination
Western Illinois University

Research Conference Coordination
West Virginia University

Conference Host
West Virginia University
Morgantown, WV

Friday, October 10, 2014

Review Process for the

North Central Research Conference

The AAAE North Central members express their sincere gratitude to AAAE colleagues who served as reviewers for research papers submitted for the 2014 North Central Research Conference. A total of 36 research manuscripts were submitted. The AAAE Protocol Guidelines for Conference Paper Selection were used in the paper review and selection process. Fifteen papers were selected for presentation at the 2014 North Central Conference.

Manuscript Reviewers for 2014 AAAE North Central Region Research Conference

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Steven Rocca
Summer Odom
Tanner Robertson
Theresa Murphrey
Tim Murphy
Todd Brashears
Traci Naile
Travis Park
Wendy Warner

2014 North Central Research Conference

Friday, October 10, 2014
8:00 A.M. to 9:30 A.M. - Research Session I

Concurrent Session A

Theme: Agricultural Mechanics
Discussant: Brad Greiman, University of Minnesota
Facilitator: Suzanna Windon, The Ohio State University

Concurrent Session B

Theme: In-Service Teacher Training
Discussant: Robert Birkenholtz, The Ohio State University
Facilitator: Laura Hasselquist, University of Missouri

Concurrent Session C

Theme: Extension and Agricultural Education
Discussant: Gary Straquadine, The Ohio State University
Facilitator: Amanda Bowling, University of Missouri

Friday, October 10, 2014
10:00 A.M. to 11:30 A.M. - Research Session II

Concurrent Session D

Theme: Inquiry Based Learning
Discussant: Daniel Foster, The Pennsylvania State University
Facilitator: OP McCubbins, Iowa State University

Concurrent Session E

Theme: Teacher Preparation
Discussant: Steve Harbstreit, Kansas State University
Facilitator: Tayloran Smith, Iowa State University

The Use of Virtual Welding Simulators to Evaluate Experienced Welders

A. Preston Byrd, Clemson University
Richard T. Stone, Iowa State University
Ryan G. Anderson, Iowa State University

Introduction

An emerging method of assessment within several industries is the immersion of individuals into a virtual reality (VR) simulation (Jones & Dages, 2003). This is the result of industry use of VR simulations to allow trainees to learn basic skills in a safer environment (Lucas, Thabet, & Worlikar, 2007). One study found that full and partial VR integration into a welding training program was appropriate, but depended on the level of task difficulty (Stone, McLaurin, Zhong, & Watts, 2013). However, the ability of VR simulations to evaluate existing skill has received limited attention.

VR environments can be used to train workers to acquire basic skills to perform the tasks required for a technical job (Manca, 2013). Manca (2013) stated that performance in a VR environment could be used as an indicator to hire an individual. Furthermore, training within a VR environment can prepare a trainee to anticipate and recognize when situations go awry, as well as to test an individual's decision-making skills under normal and stressful conditions. Such evaluation is possible through dynamic and continuously changing VR environments. Training in such environments can lead to increased memory retention, reduced human error, and a deeper understanding of the complexities of a work environment. Evaluating the critical thinking skills is also possible by evaluating how an individual adapts to changing conditions within a VR environment (Manca, 2013).

Seymour et al. (2002) found that training surgeons within a VR surgical simulation increased surgery efficiency by 20%. However, the focus of incorporating VR simulations is changing from educating novices and interns to the importance of continued training of experienced personnel. One example of experienced personnel using VR is found within aviation, where VR simulations are used to train pilots regularly regardless of experience (Gaba, 2004). Boulet et al. (2003) found medical residents scored higher than medical students did on medical VR simulations. Boulet et al. (2003) also suggested that VR simulations could play a future role in continuing medical education and recertification.

A VR simulation in certifying medical personnel is an important consideration for medical programs. Kunkler (2006) noted that several associations and training programs are considering the use of simulators for health care professionals' skills certification. For example, the Joint Commission on Allied Health Personnel in Ophthalmology (JCAHPO) uses simulations to evaluate Certified Ophthalmic Technician (COT) skills. Simulator-based evaluations have replaced hands-on skills used in JCAHPO evaluations in 250 test centers nationwide. Research has found that simulations that look and feel like actual procedures help clinicians develop skills and maintain those skills throughout their professional practice (Kunkler, 2006).

According to Giachino and Weeks (1985), for a skilled manual welder to master the craft requires years of on-the-job training. Therefore having a way to continually monitor or train experienced welders is important. Since VR simulations are currently being used to train beginners, could it be used to evaluate existing skill of current welding professionals?

Theoretical Framework

The theory of individual differences in task and contextual performance guided this study. Individual performance is described as behavioral, episodic, evaluative, and multidimensional (Motowidlo, Borman, & Schmit, 1997). Furthermore, performance is defined as an aggregate of behavioral episodes that add value to an organization. The theory of individual differences distinguishes between task and contextual performance to identify and define behavioral episodes to describe an individual's performance. According to Motowidlo et al. (1997), contextual performance refers to behaviors that influence the psychological, social, and organizational environments of an organization. Task performance refers to an individual's affect to the technical core of an organization, which assembles the products of that organization. Task performance is divided into two types of tasks. The first type of tasks includes the transformation of raw material into a finished product or service. The second includes service and maintenance of the technical core by helping restock raw materials, move finished products, planning, and supervising or coordinating the first type of task performance. For this study, the researchers focused on the first type of task performance, which is directly affected by an individual's prior experiences.

Purposes

The purpose of this study was to examine the ability of VR welding simulations to be an effective assessment tool. The researchers addressed this goal by comparing experienced welders to trained novice welders in terms of participants' VR performance. Performance was defined in terms of a quality score based on five welding parameters. For this study, the VRTEX® 360 welding simulator was selected because it is capable of providing realistic simulations that were appropriate for this study. The researchers hypothesized that a VR simulator would be able to indicate the difference between experienced welders and trained novice welders.

Methods/Procedures

Researchers utilized the VRTEX® 360 Virtual Reality Arc Welding Trainer with shielded metal arc welding (SMAW) stinger, helmet, and plastic coupons. This trainer was chosen because it was the highest fidelity VR simulator on the market at the time of this study. This VR simulator allowed users to be fully absorbed in a VR welding environment. Participants wore a welding helmet with integrated stereoscopic VR screens. This study took place at several locations to obtain a sufficient number of participants during the fall of 2013. The research sites varied between nine locations ranging from classrooms to union halls. The day, time, and number of participants at each location varied because of the specific times requested by each location.

The population of this study consisted of 49 male participants of varying ages. All participants in this study has completed a formal welding training program and currently employed as a welder. The participants were categorized as either experienced welders or trained novice welders. Experienced welders were categorized based on having at least 10 years of welding experience or are a certified welder (CW). Trained novice welders were individuals that had less than one year of experience. This study included 18 experienced and 31 trained novice welders.

At each test site, participants were evaluated on four weld types in the SMAW: 2F (horizontal fillet weld), 1G (flat groove weld), 3F (vertical fillet weld), and 3G (vertical groove weld). Participants were acclimated to the VR welding simulator and had to achieve a weld score of 75 or better prior to the data collection stage. Individuals completed test welds in the following order: 2F, 1G, 3F, 3G. Once an individual started the test welds, they had to complete all four without a break. Once completed with a weld the score for the welds were recorded.

Results

Once participants completed each test weld, a quality score was recorded (see Table 1). Differences were identified between experienced and trained novice welders in several instances. A major difference was found in the range in quality scores, in which trained novices had a wider range of scores than the experienced welders. Another difference emerged when examining the minimum quality scores. Experienced welders maintained an average minimum score in the low 70s for all weld types; the 3G weld yielded the lowest quality score at a 49. Trained novice welders' minimum scores fluctuated between 20 (3G) and 61 (2F). Examining the standard deviation, experienced welders were more consistent in ability than were trained novice welders for each weld type. Consistency amongst experienced welders was evident with the 3F weld type in which the standard deviation was 4.43.

Table 1

Quality Scores by Experience and Weld Type

Experience and Weld Type	*N*	Range	Minimum	Maximum	*M*	*SD*
Experienced 2F	18	30	70	100	86.33	7.88
Experienced 1G	18	30	70	100	84.89	8.24
Experienced 3F	18	17	72	89	82.50	4.43
Experienced 3G	18	41	49	90	77.39	10.57
Trained Novice 2F	31	38	61	99	78.94	9.05
Trained Novice 1G	31	57	32	89	74.68	11.41
Trained Novice 3F	31	38	52	90	71.97	9.10
Trained Novice 3G	31	65	20	85	62.35	16.23

When comparing the minimum score of the experienced welders and the maximum score of the trained novice welders, it is evident that there is overlap. This data illustrates that the VR simulator can evaluate current skill, but cannot accurately identify an individual as an experienced welder or a novice welder.

The test weld quality scores were averaged for each weld type by welder experience. An overall average was also calculated by averaging all scores for each experience level (see Fig. 1). Based on the data, the experienced welders outperformed the trained novice welders by an average 10 quality points. As a descriptive trend, on average experienced welders outperformed the trained novice welders on all weld types. The separation in quality scores grew progressively as weld difficulty increased. The separations in average quality scores were 2F (7.39), 1G (10.21), 3F (10.53), and 3G (15.04). Another trend that emerged was the 2F weld, the easiest weld performed by welders of both experiences levels. The scores then decreased progressively as the weld difficulty increased. Overall performance was highest among the experienced welder group with an average of 83, which was higher than the trained novice welder group by 12 quality points as illustrated in Figure 1.

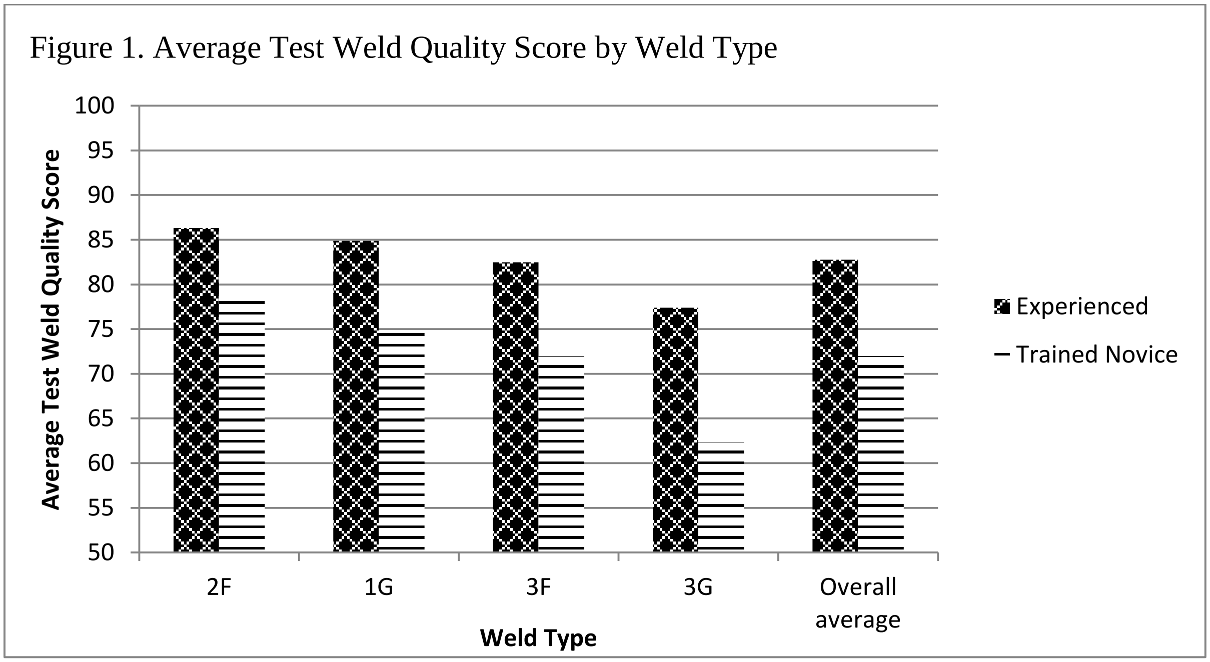

Figure 1. Average test weld quality score by weld type

After homogeneity of variance was calculated, a *t*-test was calculated for the levels of experience on all four weld types. The results identified statistical significance for all weld types with *p* values ranging from 0.000 to 0.007. These findings indicated that a significant difference existed between the experienced welders' and trained novice welders' average quality score for each weld. To examine the effect that experience had on the average quality score, Cohen's d was calculated and was interpreted following the suggestion of Gravetter and Wallnau (2009) as small (0.2), medium (0.5), and large (0.8). According to the results, experience had large effect on the 2F (2.846) and 1G (3.352) weld types.

Table 2

t-Test Results for Welder's Experience

Weld Type	*t*	*p*	*d*
2F	2.846	0.007	0.830
1G	3.352	0.002	0.977
3F	5.426	0.000	1.582
3G	3.512	0.001	1.024

Conclusions

The results of this study suggest that VR simulations can be used as assessment tools to assess existing skill levels of welders. The differences between the experienced and trained novice welders were distinct for all weld types examined. These findings support the theory of individual differences because individuals with more experiences were able to perform tasks at a higher level of success due to increased task knowledge and skill.

It can also be concluded that experienced welders as a group were able to perform significantly better than trained novice welders. Both groups showed a trend of decreasing quality scores as weld difficulty increased. The 2F and 1G welds tended to be easier for both the experienced and trained novice welders. Where the 3F and 3G welds were more complex in nature, and yielded a lower quality score from both groups. This conclusion supports the theoretcial framework as experience allows welders to perform better because of prior task knowledge and skill of each weld type. However, the quality scores were able to identify which weld types the welders were most and least competent to complete.

Because VR has demonstrated the ability to assess existing welding skills, this method could be used to track a welder's skills over time. This use of longitudinal data could be used in worker assessments for educational purposes, as well as identifying when novice welders are ready to test for certification. In a setting where VR simulation would be used to assess existing skills, a system could be put into place for routine assessment to ensure high quality welds in a production setting. The results of this study demonstrated the ability of VR simulation, specifically the VRTEX® 360, in assessing existing skills in welders in terms of a quality score based on five welding parameters (position, arc length, work angle, travel angle, and travel speed). It is also recommended to replicate this study by examining existing skill with the gas metal arc welding welding process.

References

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Teacher-perceived Adequacy of Tools and Equipment Available to Teach Agricultural Mechanics

OP McCubbins, Iowa State University
Ryan Anderson, Ph. D, Iowa State University
Thomas H. Paulsen, Ph. D., Iowa State University
Trent Wells, Iowa State University

Introduction

The inadequacy of available instructional materials can be a major concern for education stakeholders and may stem from numerous factors. Such factors could include: 1) lack of funding, 2) outdated materials, 3) lack of adequate training, and 4) lack of perceived importance (Saucier & McKim, 2010; Saucier, Terry, & Schumacher, 2009; Saucier, Vincent & Anderson, 2011; Shultz, Anderson, Shultz, & Paulsen, 2013). The insufficient supply and poor quality of instructional materials afforded to many students can create significant obstacles for students as they attempt to meet state-mandated content standards, pass examinations required for grade-to-grade promotion and high school graduation, and qualify for competitive opportunities in college and the workforce (Oaks & Saunders, 2002). With initiatives such as the No Child Left Behind Act (2002) and ever-changing standards, educators face even more challenges when they have inadequate teaching materials. Ramsey-Gassert, Shroyer, and Staver (1996) conducted a study focusing on teacher self-efficacy and its relation to internal (i.e., within immediate control of the participant) and external (i.e., beyond immediate control of the participant) factors to teach science. Ramsey-Gassert et al. (1996) found that resources were a determining factor in terms of teaching science. Teaching agricultural mechanics without adequate resources may have the same result for secondary agricultural educators. Doerfert (2011) indicated that agricultural educators, in order to provide high-quality instruction, must have access to adequate resources. Agricultural educators often face many challenges in acquiring the proper tools for superior laboratory instruction (Phipps, Osborne, Dyer, & Ball, 2008). In response to this challenge, a question has arisen: How do [STATE] agricultural educators perceive the adequacy of the tools and equipment in their agricultural mechanics facilities?

Phipps (1980) posited that the primary goal in agricultural mechanics education is the development of skills necessary to perform tasks in order to complete mechanical activities within agriculture. Without adequate teaching materials, students are limited in their mastery of these skills. The seriousness of inadequate resources is well documented throughout educational system. Interestingly, Niemann (1970, as cited in Veenman, 1984) indicated that “salaries, poor human relations among staff , inadequate building and *equipment* [emphasis added], high teaching load, training inadequacies, and large classes were the major areas of dissatisfaction of English elementary and secondary teachers” (p. 159).

The effects of inadequate resources are not limited to elementary and secondary schools alone. The lack of resources has even been documented in medical schools in Australia (Croty, 2005). Croty (2005) concluded that Australia needs more medical graduates because of a workforce shortage, but points out that there are not enough clinical hospitals, or patients in the hospitals for all the medical students to be adequately trained. Low student achievement because of a lack of resources, particularly in the medical field, is unsettling. These medical students are required to complete training programs, but do not have adequate training programs or resources to do so.

When schools provide adequate materials for educators, the materials provided may aid teachers in being able to effectively teach a topic. This is especially true in the subject of agriculture. Connors and Mundt (1999) investigated the challenges and problems teachers faced early in their career. They found that the most frequently reported problems related to time management. However, it should be noted that the participants reported problems in obtaining and inventorying teaching materials, shop tools, and equipment. Using the Delphi techniques, Connors and Mundt (1999) conducted three surveys, and then compiled the problems and challenges agreed upon by the participants from the third survey. The researchers found that 71.4% of participants classified obtaining and inventorying teaching materials, shop tools, and equipment as important, and 9.5% classified it as very important.

Conceptual Framework

The Borich (1980) Needs Assessment Model served as the conceptual framework for this study. Researchers used the needs assessment model to quantify teachers' perceived adequacy of available materials (e.g., tools) to teach concepts within the following domains of agricultural mechanics: 1) mechanic skills, 2) structure and construction skills, 3) electrification skills, 4) power and machinery skills, 5) water and soils skills. The needs assessment model (Borich, 1980) is "essentially a self-evaluative procedure which relies on the judgments of the teachers…" (p. 8). Teachers can make an objective judgment when asked to describe the adequacy of the available tools and equipment to teach agricultural mechanics. This model is implemented easily when immediate feedback is needed and when limited resources are available to retrieve such information. By utilizing this specific model, it allowed the researchers to determine the areas within agricultural mechanics in which educators feel they do not have adequate tools or materials to teach.

Problem Statement & Research Objectives

The National Research Agenda (NRA) (2011) addressed as a high priority area the importance of having a "Sufficient Scientific and Professional Workforce that Addresses the Challenges of the 21st Century" (Doerfert, 2011, p. 18). "Addressing our societal and industry challenges will require a diverse workforce that includes scientists and professionals with knowledge and skill beyond today's standards" (Doerfert, 2011, p. 19). Agricultural educators must be able to supply society with a portion of the needed professional workforce, provided they have the tools and materials needed to adequately train students, within agricultural courses. Supplying a portion of this needed workforce will be difficult to meet without adequate tools and materials to teach agricultural mechanics courses. Doerfert (2011) also proposed that "highly effective educational programs will meet the academic, career, and development needs of diverse learners in all settings and at all levels" (p. 25) as a key outcome for Priority Area 5. It also points out the difficulty in maintaining up-to-date curriculum as the technological advancements within agriculture happen so quickly. Obtaining the necessary tools to teach subjects within agricultural mechanics may be challenging to educators in many ways. How can post-secondary educators ensure that [STATE] agricultural education programs have adequate tools and materials to teach an up-to-date curriculum?

The purpose of this study was to describe the adequacy of tools and equipment used within high school agricultural mechanics laboratories as perceived by agricultural educators.

The following objectives were identified to fulfill the purpose of this study.

1. Describe the demographic characteristics of participating agricultural educators.
2. Describe the availability of selected agricultural mechanics tools and equipment as perceived by secondary agricultural educators.

Methodology

This descriptive study, which was part of a larger study in agricultural mechanics education, used survey research methods to summarize characteristics, attitudes, and opinions to accurately describe a norm (Ary, Jacobs, Razavieh, & Sorensen, 2006). A researcher-modified, paper based questionnaire was used to address the objectives of the study. The instrument contained three sections. Section one included 54 skills related to agricultural mechanics. Skills were separated into five constructs, including: Mechanic Skills, Structures/Construction, Electrification, Power and Machinery, and Soil and Water Skills. Respondents were asked to use a five-point summated rating scale to rate their perceived adequacy of available tools and equipment to teach each skill in secondary agricultural mechanics courses. Section two consisted of 15 demographic questions relating to the teacher, and section three included nine questions about program and school characteristics. Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. Following the recommendations of Dillman, Smyth, and Christian (2009), the initial electronic version of the instrument was pretested through a pilot study with a group of 12 agricultural educators in a neighboring state. Suggestions from this pilot study led researchers to adopt a paper-based, rather than electronic, instrument. Gliem and Gliem's (2003) suggestion on calculating post-hoc reliability was used, resulting in a reliability coefficient for adequacy (α = 0.97).

Data were collected through convenient sampling methods and conducted during the 2011 [STATE] agricultural educators' conference. This population was purposefully targeted because of their likelihood to be involved in additional professional development activities. Researchers distributed a questionnaire to each secondary instructor (N = 130) in attendance and asked that it be completed by the end of the conference. Safety curriculum from the power tool institute was offered as an incentive for completing and returning the questionnaire. These efforts yielded a sample of 103 usable instruments for a 79.2% response rate. No additional effort was made by the researchers to obtain data from non-respondents. As a result, non-response error was addressed following the suggestions of Miller and Smith (1983) by comparing respondents' personal and program demographic data to data from the [STATE] Department of Education (2010). A Pearson's χ^2 analysis yielded no significant differences $(p > .05)$ for gender, age, highest degrees held, years of teaching experience, or size of school community between respondents and the general population of agricultural educators in [STATE]. Data from this study should be interpreted with care and not extrapolated beyond the target population based on the purposefully selected sample. Data were coded and analyzed using PASW Statistics 18.

Results

Data from Table 1 described agricultural educators' perceived most adequate supply of tools to teach agricultural mechanics. The highest tool supply adequacy levels were found in the areas of welding safety, shielded metal arc welding (SMAW), construction and shop safety, wood working power tools, wood working hand tools, and bill of materials.

Table 1

Agricultural Educators' Perceived Most Adequate Supply of Tools to Teach Mechanics Skills (n = 101)

		No Need	Some	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Welding Safety	93	7(7.5)	8(8.6)	22(23.7)	29(31.2)	27(29.0)
SMAW Welding (ARC)	94	7(7.4)	16(17.0)	23(24.5)	25(26.6)	23(24.5)
Construction & Shop Safety	89	11(12.4)	7(7.9)	18(20.2)	34(38.2)	19(21.3)
Wood Working Power Tools	89	8(8.9)	11(12.4)	22(24.7)	31(34.8)	17(19.1)
Wood Working Hand Tools	90	8(8.9)	13(14.4)	23(25.6)	30(33.3)	16(17.8)
Bill of Materials	88	12(13.6)	10(11.4)	21(23.9)	33(37.5)	12(13.6)

Data from Table 2 below described agricultural educators' perceived least adequate supply of tools to teach agricultural mechanics. The lowest tool supply adequacy levels were found in the areas of profile leveling, fencing, differential leveling, cleaning motors, and tractor selection.

Table 2

Agricultural Educators' Perceived Least Adequate Supply of Tools to Teach Mechanics Skills (n = 101)

		No Need	Some	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Profile Leveling	75	40(53.3)	18(24.0)	11(14.7)	5(6.7)	1(1.3)
Fencing	80	42(52.5)	16(20.0)	15(18.8)	6(7.5)	1(1.3)
Differential Leveling	76	39(51.3)	19(25.0)	10(13.2)	7(9.2)	1(1.3)
Cleaning Motors	78	37(47.4)	18(23.1)	15(19.2)	7(9.0)	1(1.3)
Tractor Selection	79	35(44.3)	21(26.6)	16(20.3)	7(8.9)	0(0.0)

Conclusions, Implications, & Recommendations

Based on these findings, it can be concluded that agricultural mechanics laboratories in [STATE] are poorly equipped to teach many subjects within agricultural mechanics. In terms of percentages, data indicates that agricultural educators in [STATE] were most prepared to teach welding safety versus all other concepts with agricultural mechanics. This finding is of great concern to teacher educators in [STATE], as many agricultural educators may not, due to a reported lack of available tools, be prepared to adequately teach agricultural mechanics as a whole. As basic agricultural mechanics competence is important to prospective agricultural industry employers (Slusher, Robinson, & Edwards, 2011), it is important that agricultural educators be prepared to teach a wide range of mechanics-related topics. Doerfert (2011) noted that agricultural technology is in a constant state of change, and teachers must be prepared to properly educate students in this dynamic, ever-changing field. Furthermore, he explained that the demand for high-skill, high-wage workers drives the need to fill positions with knowledgeable and skilled candidates. Based on the findings it can also be concluded that not all secondary agricultural educators teach each construct in which the adequacy was researched.

Regarding these conclusions some questions arose in the researchers' minds. Could the reported tool inadequacies reflect upon teachers' beliefs regarding the importance of these topics? Shultz et al. (2013) compiled a listing of selected agricultural mechanics topics which detailed teachers' perceptions of importance to teach. It is interesting to note that many of the topics within the present study that held lower levels of tool adequacy also held lower levels of importance within Shultz et al.'s (2013) work. Many of the areas that Shultz et al. (2013) reported as having high importance were reported in the present study as having higher levels of tool adequacy. This finding seems to suggest the possibility that secondary agricultural educators may have worked harder to ensure that tools are available for topics that they perceived to be important. The following question also came to mind: Does tool availability reflect upon teachers' content selections? Comparison of data between this work and Shultz et al.'s (2013) work may lend some insight into the answer to this question.

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Teacher Perceptions of Appropriateness of Agricultural Mechanics Concepts taught in Secondary Agricultural Education Programs

Elly Stremsterfer, Iowa State University
Jaclyn F. Tweeten, Iowa State University
A. Preston Byrd, Clemson University
Ryan G. Anderson, Iowa State University
Thomas H. Paulsen, Iowa State University

Introduction

Agricultural mechanics coursework has historically been considered an important component of the secondary agricultural education curriculum (Anderson, Velez, & Anderson, 2011; Wells, Perry, Anderson, Shultz, & Paulsen, 2013). With agricultural mechanics being such a broad content area it is important to understand what areas agricultural education teachers feel are appropriate for secondary programs. In Missouri teachers believed safety was the most important competency to teach (Saucier & McKim, 2011).

Burris et al. (2005) found that 90% of the agricultural education programs in Missouri taught six of nine identified content areas of agricultural mechanics. The six areas identified were metal fabrication, hand/power tools, project planning and materials selection, electricity, and building construction. Furthermore, more than 80% of programs also taught plumbing, concrete, and machinery and equipment.

A local control state allows school districts to choose what content to teach (Iowa Department of Education, 2012). McCulloch, Burris, and Ulmer (2011) indicated that multiple stakeholders are involved in determining the content taught in the agricultural education curriculum; however, the agricultural education teacher decides what is in the curriculum. The ability to pick the curriculum allows agricultural education teachers to have a significant influence over what students' learn (Park & Osborne, 2007; Sankey & Foster, 2012), so how does a teacher decide what to include? Heimgartner and Foster (1981) investigated the agricultural education instructors' perceptions of knowledge and the importance of agricultural mechanics areas and found a variation in knowledge contributable to the institution where they received agricultural mechanics training.

Agricultural education seems to be dominated by males, whereas the teaching profession seems to be female dominated (Rocca & Washburn, 2008). With low numbers, research has indicated that the percentage of women in agricultural education is increasing (Camp, 2007; Camp, Broyles, & Skelton, 2002; Kantrovich, 2007). As there is an increase in women who teach agricultural mechanics, would there be any perceived difference in what agricultural mechanics competencies are appropriate for secondary programs between genders?

Conceptual Framework

The conceptual framework that guided this study was the five-step process in determining curriculum from Ball and Cohen (1996). A teacher's perception of what is appropriate in a particular course is based on a process. First, teachers take into consideration student interests. Wells et al., (2013) suggested that the training received at the secondary level has an influence on students' interest to continue learning agricultural mechanics. Second, teachers work with personal understanding of the content, which helps the teacher structure the curriculum for students.

Third, is instructional design for students, where teachers create instructional material, choose activities, and navigate educational resources. Fourth is the intellectual and social environment of the class, which involves classroom management and learning theories used to maximize student engagement. Finally, teachers are influenced by personal views of the community, parents, administrators, and professional organizations. Teachers' interpretation of messages regarding instructional goals and good teaching plays a role in how the curriculum is shaped (Ball & Cohen, 1996).

Purpose and Objectives

With industry changing, agricultural education curriculum needs to change as well. This study aligns with Priority Area 5: the Efficient and Effective Agricultural Education Programs (Doerfert, 2011). *In order to meet the demands of the industry, agricultural education programs need to continue to keep pace.* It is important to identify what teachers feel as appropriate to include in a high school agricultural education program. The purpose of this study was to describe teachers' perceived appropriateness of agricultural mechanics topics in secondary agricultural education curriculum. The following objectives were identified for this study.

1. Describe the demographics of agricultural education teachers.
2. Describe the perceived appropriateness of agricultural mechanics topics in secondary agricultural education curriculum as described by Iowa agricultural education teachers.
3. Describe the difference in perceived appropriateness of agricultural mechanics topics in secondary agricultural education curriculum as described by Iowa agricultural education teachers' gender.

Methodology

This descriptive study was part of a larger study and used survey research methods to summarize characteristics, attitudes, and opinions to accurately describe a norm (Ary, Jacobs, Razavieh, & Sorensen, 2006). A researcher-modified, paper-based questionnaire was used in this study. Section one asked respondents to use a five-point summated rating scale to rate their perceptions of importance of teaching each skill in secondary agricultural education and their competency to teach each skill. Section two consisted of 15 teacher demographic questions, and section three included nine program and school characteristics questions. Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. Following the recommendations of Dillman, Smyth, and Christian (2009), the initial electronic version of the instrument was pretested through a pilot study with a group of 12 agriculture teachers in a nearby state. Suggestions from this led researchers to adopt a paper-based survey. Post-hoc reliability was estimated following the suggestions of Gliem and Gliem (2003) and resulted in reliability coefficients for appropriateness ($\alpha = 0.97$).

Data were collected through a convenience sample of agricultural education teachers who attended the 2011 Iowa agricultural education teachers' conference. This population was purposively targeted because of their likelihood to participate in additional professional development activities. Researchers distributed a questionnaire to each secondary instructor (*N* = 130) in attendance and asked that it be completed by the end of the conference, which yielded a sample of 103 usable instruments for a 79.2% response rate. No further effort was made to obtain data from non-respondents. As a result, non-response error was addressed following the suggestions of Miller and Smith (1983) by comparing respondents' personal and program demographic data to data from the Iowa Department of Education (2010). A Pearson's χ^2 analysis yielded no significant differences $(p<.05)$ for gender, age, highest degrees held, years of teaching experience, or size of school community between respondents and the general population of agriculture teachers in Iowa. However, due to the purposively selected sample, data from this study should not be extrapolated beyond the target population. Data were coded and analyzed using PSAW 18.0.

Results

The first objective sought to describe the demographics of the agricultural education instructors in Iowa. The typical respondent was a male (n=69) in a single teacher program (n=91) in a rural community (n=80), and held a Bachelor's degree (n=64). Objective two sought to describe the perceived appropriateness of agricultural mechanics topics in secondary agricultural education curriculum. In the mechanics construct, a majority of respondents described six skills as very important. These skills included welding safety, construction site and shop safety, SMAW welding, mechanical safety, and electrical safety. No competencies were found to be inappropriate for secondary agricultural education programs.

In the structure and construction construct, the three skills rated with the highest level of appropriateness included construction and shop safety, woodworking power tools and bill of materials. The three skills that received the lowest appropriateness ratings included concrete, drawing and sketching, and fasteners. Within the electrification construct, two skills that were rated with the highest level of appropriateness included electrical safety and wiring skills. The two skills rated lowest included cleaning motors and types of electrical motors. Three skills within the power and machinery construct were rated with the highest level of appropriateness included small engine safety, power and machinery safety, and small engine overhaul. The three lowest rated skills included tractor overhaul, tractor selection and machinery selection. The soil and water construct had two skills that were rated the highest level of appropriateness for an agricultural education program included Global Positioning Systems (GPS) and legal land descriptions. The two skills that were rated the least appropriate for an agricultural education program included profile leveling and differential leveling.

Objective three sought to describe the difference in perceived appropriateness of agricultural mechanics topics in secondary agricultural education curriculum as described by Iowa agricultural education teachers' gender Statistical differences were found between genders in the structures and construction construct χ^2 (27, n=84) = 40.90, p<.05 and the electrification construct χ^2 (21, n=80) = 35.76, p<.05. Descriptively, males perceived themselves more competent than females in all constructs except the soil and water construct. The largest difference in average competence was found within the electrification construct (males=3.74, females=3.56).

Conclusions and Discussions

The purpose of this study was to identify the teacher perceptions for including agricultural mechanics concepts in high school agricultural education programs in Iowa. Objective one sought to describe the demographics of Iowa agricultural education teachers.
Objective two sought to describe the teacher perceived appropriateness of agricultural mechanic topics in a high school agricultural education program. It can be concluded that overall agricultural education teachers perceived safety as the most important competency to teach within an agricultural mechanics curriculum. This supports Saucier and McKim's (2011) findings that safety is the most important competency in an agricultural mechanics curriculum.

Teachers felt welding safety was very important to include in the curriculum. This supports Burris, Robinson, and Terry's (2005) study that found metal fabrication is taught in majority of all Missouri agricultural education programs. One can conclude that if metal fabrication is an area taught, safety content would be vital.

One can conclude that agricultural educators perceived all the competencies in this study appropriate. It can also be concluded that agricultural education teachers perceived all the competencies within electrification appropriate except types of electrical motors. This supports Burris, Robinson and Terry's (2005) findings where 98.5% of Missouri agricultural education programs have electricity in their curriculum. Do teachers feel that electrical motors content is no longer relevant?

Within power and machinery skills, it can be concluded that teachers perceive safety as the most appropriate. Areas relating to tractors and machinery were ranked moderately appropriate. Agricultural education instructors must take into account students need, although areas such as this may not be offered in all localities. The lower perceived appropriateness may be contributed to the declining number of small family farms or the lack of resources to teach the competencies. When looking at the conceptual framework, another plausible explanation could be that tractor related competencies might not have been taught in the agricultural mechanics courses that agricultural education teachers completed.

Agricultural education instructors reported that Global Positioning Systems (GPS) content has a 'very strong' appropriateness for inclusion in a high school agricultural education program. This could be due to the change in technology and the accessibility to this technology. Differential and profile leveling are not areas in which agricultural education instructors perceived as important. This could be due to the change in technology as well, or the lack of tools to teach the content. Although, the use of survey equipment had a 'very strong' appropriateness rating and supports Saucier and McKim's (2011) findings where surveying was found to be an essential skill needed by agricultural education teachers.

Objective three sought to describe the difference in appropriateness of agricultural mechanics skills of Iowa agricultural education teaches by gender. It can be concluded that there are differences in perceived appropriateness of agricultural mechanics skills between genders. With an increase of females in the agricultural education profession, new and unseen perceptions about agricultural mechanics are emerging. One theme that emerged was the difference in appropriateness for structures/construction and electrification skills in agricultural education curriculum.

Recommendations and Implications

Several recommendations can be made from the conclusions of this study. One recommendation is to provide professional development opportunities for the agricultural education teachers perceived as appropriate for agricultural education curriculum. In addition, workshops that will help agricultural education teachers design program curriculum is needed to help give teachers the ability to build a strong program.

The researchers recommend exploring why teachers have identified certain skills as appropriate. This research would provide additional insight into to why agricultural education instructors chose to teach certain skills over others. This additional research would also assist teacher education programs to align post-secondary agricultural mechanics curriculum with the areas that secondary teachers deemed appropriate. If it is determined that the reason for some skills to be identified as less appropriate is due to lack of self-efficacy, then a workshop could be held. For example, teachers have identified the use of surveying equipment as highly appropriate, however the application of that equipment such as profile and differential leveling was perceived as ‘some’ appropriate.

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Obstacles, Activities and Professional Development Needs of Mid-Career Agriculture Teachers

Scott Smalley, South Dakota State University
Amy R. Smith, University of Minnesota

Introduction

Recruitment and retention is a priority in many areas of career and technical education, as a significant gap exists between teacher supply and demand (Wilkin & Nwoke, 2011). Agricultural education is no different, having a recognized shortage of teachers across the nation (National Teach Ag Campaign, 2014). Several state and national efforts have been established to address this need, including student loan forgiveness programs, upperclassmen scholarship programs, and the National Teach Ag Campaign's State Teach Ag Results (STAR) program.

In "Teacher Shortage Undermines CTE" (Conneely & Uy, 2009) several factors contributing to the shortage are identified. An increase in student enrollment, discontinuation of teacher education programs, and a large number of CTE teachers nearing retirement have contributed to a crisis (Conneely & Uy, 2009). "Student demand requires more teachers, but teachers are leaving the profession and the opportunities to cultivate new educators are limited as teacher programs are eliminated" (Conneely & Uy, 2009, p. 1).

The answer to this shortage – for agricultural education and career and technical education – is not merely recruiting more teachers. Cochran-Smith (2004) stated a "teacher shortage is in large part a demand problem that can be solved only if we decrease demand by increasing retention" (p. 390). Berman (2004) continues, "talented teachers will not last long in a culture that undermines or is neutral to their needs and interests, leaves them isolated, or fails to promote their growth" (p. 118). Berman suggests a "critical period" exists for teachers with 4-6 years of experience, when they decide whether or not to continue in education (2004, p. 133). Earlier, challenging professional development, the opportunity for leadership roles, and dialogue with colleagues can increase commitment and retention (Berman, 2004).

Ingersoll's (2003) research suggested a majority of turnover occurs during the first five years on the job. Agricultural education research has echoed that sentiment, suggesting that beginning teachers are faced with many challenges and demands that contribute to the decision of leaving the profession (Myers, Dyer, & Washburn, 2005). However, teachers at all stages of career life face professional challenges and have unique needs that must be met in order to retain them in the profession.

Framework

A variety of models explain career life-cycle of teachers, recognizing characteristics, challenges, and development needs in each stage (Fessler, 1985; Huberman, 1995; Steffy & Wolfe, 2001). Each suggests that to retain teachers and ensure a positive trajectory through the career life-cycle, opportunities for professional development, support and renewal must be provided. Earlier and more challenging professional development, the opportunity for leadership roles, and deeper dialogue with colleagues are cited as ways to increase commitment to a school district and profession.

Describing the stages as “Survival and Discovery” from 1-3 years, “Stabilization” from 4-6 years, “Experimentation/Activism” and “Reassessment/Self-Doubt” from 7-18 years, “Serenity/Relational Distance” and “Conservatism” from 19-30 years, and “Disengagement: Serene or Bitter” from 31-40 years, Huberman (1989) asserted the phases at mid-career are the most variable and extensive. In the fourth phase, teachers engage in self-questioning and may consider a career change. Further, Huberman discovered that teachers tend to associate three things with their most satisfying experiences in mid-career: 1) a role shift, 2) strong rapport with special classes or groups of students, or 3) significant results.

Similarly, Steffy and Wolfe’s (2001) model is rooted in transformative learning and emphasizes the importance of the reflection-renewal-growth cycle. This model too, suggests the value of self-questioning resulting in positive answers. Specifically, they offer the following:

> … The Life Cycle Model is an application on Mezirow’s transformation theory. As teachers progress throughout their careers, they can engage in transformational processes including critical reflection on practice, redefinition of assumptions and beliefs, and enhanced self-worth. Or they can disengage from the work environment as a source and stimulation for new learning and begin the gradual decline into professional withdrawal (Steffy & Wolfe, 2001, p. 17).

Until recently, many professional development programs in agricultural education focused on early career teachers. State mentoring or induction programs, regional “new teacher” workshops and the NAAE Teacher Turn the Key program provide excellent resources and support for beginning agriculture teachers. However, there appears to be a lack of professional development specifically designed for mid-career agricultural education teachers. In 2013, the National Association of Agricultural Educators (NAAE) recognized the need for such professional development and developed the eXcellence in Leadership for Retention (XLR8) program to meet the needs of teachers with 7-15 years of teaching experience. Research regarding this initiative will better enable state and national leaders to identify and meet professional development needs of agricultural educators in this particular stage of the career cycle model, a priority expressed in the American Association of Agricultural Education (AAAE) National Research Agenda (Doerfert, 2011).

Purpose/Objectives

The purpose of this qualitative study was to explore self-reported challenges, activities and professional development needs of mid-career agricultural educators, particularly those within the “Experimentation/Activism” and “Reassessment/Self-Doubt” stages identified by Huberman (1989). Specifically, three research questions guided this study.

1. What are the biggest obstacles that prevent mid-career agricultural educators from becoming the teachers they wish to be?
2. How do mid-career agricultural educators stay professionally prepared and up-to-date in teaching techniques and technical content?

3. What goals or objectives do applicants wish to achieve from a targeted mid-career professional development experience?

Methodology

Creswell (1998, p. 15) described qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explores a social or human problem." This study utilized the qualitative method of content analysis to better understand challenges, activities and professional development needs of mid-career agricultural educators. The population included thirty-five agricultural educators with seven to fifteen years of teaching experience. Each had applied to participate in the first annual eXcellence in Leadership for Retention professional development program, offered by National Association of Agricultural Educators (NAAE). NAAE provided the frame for the study, as well as access to the written materials submitted by each applicant. To maintain confidentiality, all personal identifications were removed.

To answer the three guiding research questions, written materials for each of the thirty-five applicants were analyzed through content analysis techniques to identify themes. Particularly, participants' responses to three open-ended questions on the program application were utilized. As applications were reviewed and transcribed, responses were open-coded, creating a master list of codes (Merriam, 2009). These codes were then grouped using axial coding, categorized systematically and informed by the study's purpose (Merriam, 2009). Application transcriptions were re-read and categories refined, revised, and consolidated as analysis continued. Finally, primary categories or themes were named. The findings were cautiously analyzed and statements were contemplated before being subjected in the final draft. Trustworthiness and reliability of data were established through a research log, peer review of data analysis and member checks.

Findings

Of the mid-career agriculture teachers who applied to the XLR8 program, the majority of applicants were female (n=23). Applicants represented all NAAE regions, with eight applicants from Region I, four from Region II, 10 from Region III, seven from Region IV, two from Region V, and 4 from Region VI. Twenty of the applicants were from multi-teacher programs, while the remaining 15 were in single-teacher programs. As a result of qualitative analysis, primary themes emerged from responses to each of the questions posed to applicants.

A lack of time, or time management challenges, emerged as a significant obstacle *"to becoming the teacher you want to be*". In fact, nineteen of thirty-five applicants indicated time as a concern. Five additional applicants noted work/life balance concerns, which relates to time management and the challenge of balancing personal and professional responsibilities. One teacher described,

> I want to be a great teacher, a great husband, and a great dad. It's extremely hard to be really good at all three of these at once. It always seems that some part is usually neglected in some form at some time. ...there's so much that is asked of teachers today that wasn't required ten years ago.

Another stated, “Online lesson plans, response to intervention, faculty meetings, professional learning communities, and other innovations in education are always demanding more time of teachers.” Another explained, “I have found that there is not enough time to refine, design and improve class lessons and learning activities as regularly as I believe they should be.” Yet another shared, “Balancing family, FFA, classroom duties, advisor responsibilities, practice- not to mention staff meetings, progress reports, grades, IEP meetings, etc… there’s so much more to being a teacher than just teaching.”

A secondary theme, specifically noted by eight applicants, related to obstacles for mid-career agriculture teachers included course planning, particularly with regards to content knowledge, locating curriculum and classroom resources, and developing lesson plans.

Applicants identified many means of “*staying professionally prepared and up-to-date*”. Participation in professional organization activities, participating in teacher listservs, and networking through NAAE Communities of Practice was the most identified theme in this area, reported by twenty-nine applicants. One applicant offered, “Conferences have allowed me to meet other educators, learn from their experiences and take that new knowledge back to my own classroom, so my students benefit from them as well.” Another shared that “staying involved professionally has helped me become a better teacher.”

Numerous other applicants noted specific professional development, offered at the school district, state, regional or national level that was particularly beneficial. Several state association conferences, regional NAAE conferences and NAAE annual conferences were noted, in addition to Curriculum for Agricultural Science Teachers (CASE) institutes. One teacher noted, “I am constantly involved in trainings to fuel improvement in my abilities.” Others mentioned business and industry involvement and reading professional magazines as beneficial ways of staying professionally prepared.

These mid-career teachers were applying to participate in the inaugural XLR8 program; they each specific, personalized goals for the outcome of the program. When asked what they “*wanted to take away from the professional development experience*”, networking, becoming reenergized and better handling stress emerged as primary themes. One teacher described “… exposure to effective, proven methods of helping a professional deal with stress, increased workloads, and balancing…” Another openly shared, “I would like to reenergize myself and rediscover the reason I became a teacher. I want the excitement I had when I was first starting out.”

Conclusions/Recommendations

This study was a census of thirty-five mid-career agriculture teachers, designed to explore their self-reported challenges, activities and professional development needs. The intent was not to generalize the results to all mid-career agriculture teachers, but rather to describe the population of mid-career teachers who self-selected to apply for targeted professional development through the XLR8 program. Caution should be taken to not generalize the results to broader populations.

Based upon the themes identified through examination of data provided on applications completed by the mid-career teachers, the following conclusions are offered. Overall, this group of mid-career agriculture teachers was interested in personal and professional development opportunities offered by this program, which may differ from teachers at other career stages. Specifically, mid-career challenges with time management, work/life balance, and course/lesson preparation were frequently mentioned. Teachers in this group expressed a desire for connections, collaboration, and support. These findings are consistent with recent research, by Sorensen and McKim (2014), that suggested that mid-career agriculture teachers (6-19 years of teaching experience) in Oregon were identified as having the lowest work/life balance and lowest professional commitment.

Despite having survived the initial years in the profession, perhaps these mid-career teachers experience unique pressures as a result of their role in leading established programs that require a significant amount of time and energy. Many applicants noted the importance of professional development to career success and expressed a desire for help balancing work and family lives. As one applicant offered, “I want to be a great teacher, a great husband, and a great dad.” This desire to succeed in all aspects of life, professionally and personally, may require additional support in order to retain agriculture teachers into the later stages of the career life-cycle.

As a result of these findings, recommendations for practice and research can be made. Certainly, additional professional development opportunities for mid-career teachers should be provided, focusing on providing solutions to the obstacles teachers are facing. Additionally, targeted professional development for teachers at other career stages should be developed as well. Agricultural education leaders should note the need for further research on mid-career agriculture teachers, much like that conducted regarding pre-service and early career teachers. Further research should be conducted to see if similar themes emerge with larger, or more diverse, audiences. Following opportunities such as this, evaluative studies should be conducted to determine if participants’ needs were met, and assess the overall impact of the program.

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The Relationship of Quality and Quantity of Agricultural Mechanics Training in Agricultural Post Secondary Preparation in the State of [State]

Nicole Gent, Iowa State University
Taylorann K. Smith, Iowa State University
Dr. Ryan Anderson, Iowa State University
Dr. Thomas Paulsen, Iowa State University

Introduction

Agricultural mechanics courses have been a foundational piece of agricultural education since 1917 when agriculture first became a part of the public education system (National FFA). Secondary agricultural education teachers are the sole providers for most agricultural mechanics courses and have an inherent expectation to offer agricultural mechanics coursework. "Vocational agriculture instruction develops abilities in constructive thinking and problem solving which enables the student to have a better command of the [fundamental processes]" (Cook, 1947 p. 5). Agricultural education courses, including those in agricultural mechanics, give students the opportunity to develop hands-on skills (Parr, Edwards, & Leising, 2009). Agricultural mechanics courses are a vital part of any agricultural curriculum, and secondary agricultural education teachers need to be prepared to address curriculum needs in this area.

Burris, McLaughlin, McCulloch, Brashears, & Fraze (2010) suggested that many secondary agricultural education teachers do not feel comfortable teaching agricultural mechanics when compared to other agricultural content areas. On average, pre-service secondary agricultural education teachers are only required to complete one to two agricultural mechanics courses to meet certification requirements to be qualified to teach agricultural mechanics (Hubert and Leising, 2000). Research has shown that previous experience in agricultural mechanics creates higher self-confidence when teaching that subject (Burris et al., 2010; Stripling & Roberts, 2012; Wells, Perry, Anderson, Schultz, & Paulsen, 2013). The assessment of students in agricultural education courses, such as agricultural mechanics, have led to changes in curricula, integrating more course offerings and repurposing programs to improve student learning and academic preparation (Parr, Edwards, Leising, 2009).

Theoretical Framework

The Teacher Professional Learning and Development Best Evidence Synthesis model (Timperley, Wilson, Barrar, & Fung, 2007) highlights how teachers can effectively access and use prior knowledge and training in their daily practice and is shown in Figure one. No Child Left Behind defines a highly qualified teacher as demonstrating competence in subject knowledge and teaching. According to the National Dissemination Center for Children with Disabilities a highly qualified teacher is one that "has demonstrated a high level of competency in each of the academic subjects in which the teacher teaches" (2014, n.p.). Therefore, a secondary agricultural education teacher should be competent in teaching agricultural mechanics. Do secondary agricultural education teachers who received more university training in agricultural mechanics also perceive that training to be better? Burris et al., (2010) suggested that many secondary agricultural education teachers do not feel as comfortable teaching agricultural mechanics as compared to other agricultural content areas.

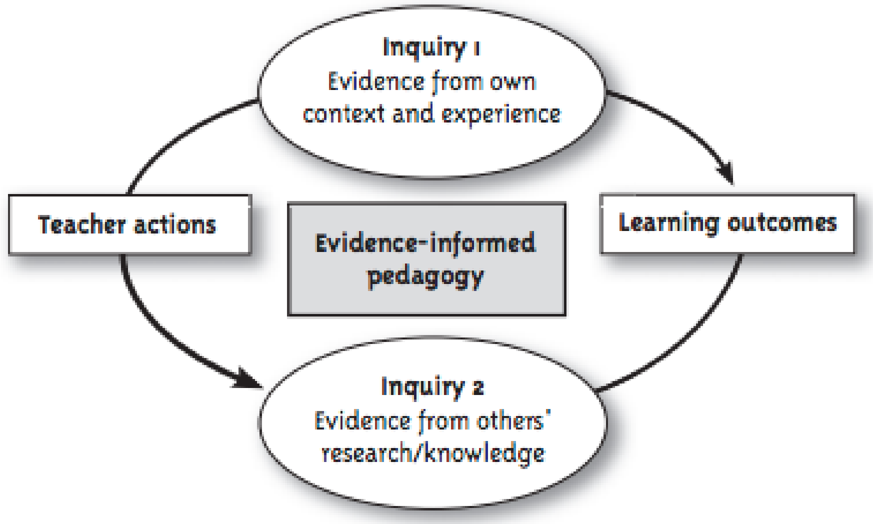

Figure 1. Teacher Professional Learning and Development Best Evidence Synthesis model (Timperley, Wilson, Barrar, & Fung, 2007).

Purpose and Objectives

The purpose of this study was to determine potential relationships between the quality and quantity of training received by secondary agricultural education teachers at the post-secondary level. This study aligns with the American Association for Agricultural Education's National Research Agenda (Doerfert, 2011) Research Priority Area 3: Sufficient scientific and professional workforce that addresses the challenges of the 21st Century. This study also aligns with the National Career and Technical Education Research Agenda Research Problem Area: 3 Delivery Methods. More specifically, the research relates to Research Activities: 3.1.1 CTE Teacher Preparation (Lambeth, Murphrey, Elliot, & Joerger, 2009). The following objective guided this study: Examine correlational relationships between quantity of university training and quality of university training.

Methods and Procedures

This descriptive study used survey research methods to summarize characteristics, attitudes, and opinions to accurately describe a norm (Ary, Jacobs, Razavieh, & Sorensen, 2006). A researcher-modified, paper based questionnaire was used to address the objectives of the study. The instrument contained three sections. Section one asked respondents to rate the quality and quantity of training received in 54 skills related to agricultural mechanics. Skills were separated into five disciplines, including: mechanic skills, structures/construction, electrification, power and machinery, and soil and water. Respondents rated their perceptions using a five-point summated rating scale. They rated the importance of teaching each skill in secondary agricultural education and competency of each skill. Section two consisted of 15 demographic questions relating to the teacher, and section three included nine questions about program and school characteristics. Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. Following the recommendations of Dillman, Smyth, and Christian (2009), the initial electronic version of the instrument was piloted study with a group of 12 secondary agricultural education teachers in a nearby state. Suggestions from this pilot study led researchers to adopt a paper-based instrument instead. Post-hoc reliability was estimated following the suggestions of Gliem and Gliem (2003) and resulted in reliability coefficients for importance ($\alpha = 0.97$) and competency ($\alpha = 0.98$).

Data was collected through a census conducted during the 2011 [State] association of agricultural educators (SAAE) teachers' conference. This population was purposively targeted because of their likelihood to be involved in additional professional development activities. Researchers distributed a questionnaire to each secondary instructor (N = 130) in attendance and asked that it be completed by the end of the conference. Each participant was offered a power tool institute safety curriculum as an incentive for completing and returning the questionnaire. These efforts yielded a sample of 103 usable instruments for a 79.2% response rate. No further effort was made to obtain data from non-respondents. As a result, non-response error was addressed following the suggestions of Miller and Smith (1983) by comparing respondents' personal and program demographic data to data from the [state] Department of Education (2010). A Pearson's $\chi 2$ analysis yielded no significant differences ($p > .05$) for gender, age, highest degrees held, years of teaching experience, or size of school community between respondents and the general population of agriculture teachers in [state]. However, due to the purposively selected sample, data from this study should be interpreted with care and not extrapolated beyond the target population. Data were coded and analyzed using PSAW Version 18.0.

Spearman correlations were used in this study to examine potential relationships between the amount of agricultural mechanics training and skills respondents indicated receiving at the secondary and post-secondary level. The magnitude of the correlations were interpreted using the Davis Convention (1971) and are as follows: those between .01 and .09 were determined negligible, those between .10 and .29 were determined low, those between .30 and .49 were determined moderate, those between .50 and .69 were determined to be substantial, and those .70 or higher were determined to be very strong.

Results

The objective of this study sought to describe the correlational relationships between quantity and quality of training received in agricultural mechanics at the University level. Each skill is correlated within the corresponding skill area rather than across skill areas. For example, the quantity of oxy-acetylene welding training was correlated to the quality of oxy-acetylene training at the University level. The vast majority of secondary agricultural education teachers were employed by rural school districts (*n*=80, 79.2%) with single-teacher departments (*n*=91, 90%). Over one-half of respondents (*n*=54, 52%) reported 10 or fewer years of teaching experience.

The data presented in Table 1 depicts the relationship between the agricultural mechanics skills in which respondents rated the quantity and quality of training received at the post secondary level. It should be noted that all 54 skills had a significant relationship.

Table 1

Spearman Rho Correlations between Quantity and Quality of University Training for Agricultural Mechanic Skills

Instructional Items	*n*	r_s
Oxy-acetylene Welding	93	.874*
Oxy-acetylene Cutting	93	.840*
Oxy-propylene Cutting	81	.836*
Plasma Cutting	88	.857*
SMAW Welding (Arc)	94	.894*
GMAW Welding (Mig)	90	.908*
GTAW Welding (TIG)	81	.835*
Welding Safety	94	.872*
Metallurgy and Metal Work	83	.846*
Hot Metal Work	82	.929*
Cold Metal Work	83	.925*
Tool Conditioning	82	.902*
Oxy-acetylene Brazing	88	.863*
Soldering	86	.823*
Pipe Cut. And Threading	81	.870*
Plumbing	84	.855*
Fencing	82	.844*
Mechanical Safety	87	.832*
Computer Aided Design (CNC)	81	.708*
Wood Working Hand Tools	90	.940*
Wood Working Power Tools	90	.939*
Drawing and Sketching	82	.929*
Concrete	84	.927*
Selection of Materials	85	.929*
Bill of Materials	86	.896*
Fasteners	84	.902*
Construction Skills (Carpentry)	88	.930*
Construction and Shop Safety	89	.932*
Electricity Controls	83	.848*
Wiring Skills (Switches and Outlets)	85	.824*
Electrician Tools	85	.791*
Types of Electrical Motors	80	.877*
Cleaning Motors	78	.863*
Electrical Safety	84	.825*

Note. $^*p < .05$.

Table 1 Continued

Spearman Rho Correlations between Quantity and Quality of University Training for Agricultural Mechanic Skills- Continued

Instructional Items	*n*	r_s
Small Engine Services - 2 Cycle	82	.914*
Small Engine Services - 4 Cycle	83	.928*
Small Engine Overhaul	83	.933*
Small Engine Safety	83	.927*
Tractor Service	77	.863*
Tractor Maintenance	77	.855*
Tractor Overhaul	76	.810*
Tractor Selection	75	.845*
Tractor Operation	76	.873*
Tractor Safety	78	.913*
Tractor Driving	77	.876*
Service Machinery	76	.880*
Machinery Selection	77	.899*
Machinery Operation	78	.897*
Power and Machinery Safety	81	.912*
Global Positioning Systems (GPS)	81	.930*
Use of Survey Equipment	80	.911*
Differential Leveling	73	.874*
Profile Leveling	74	.906*
Legal Land Descriptions	83	.875*

Note. *$p < .05$.

Conclusions/Implications

From the data presented as a result of this study, researchers can conclude that there is a strong positive correlation between the amount (quantity) of training and the quality of training that secondary agricultural education teachers receive at the post secondary level. While the strong correlation does not imply causation, it does allow researchers to infer that the quality of courses taught are connected to the quantity of agricultural mechanics courses offered to post secondary agricultural education teachers. These findings are supportive of past research stating that teachers' prior experience and training have a large impact on the students that they teach. The Teacher Professional Learning and Development Best Evidence Synthesis (Timperley, Wilson, Barrar, & Fung, 2007) has the potential to help complete the educational loop by showing teachers how to effectively access and use prior knowledge and training in their daily practice. In the case of this study, *more* really is better for secondary agricultural education teachers. The strong correlation supports the notion that secondary agricultural education teachers who receive more university training perceive the training to be of higher quality. On average, pre-service secondary agricultural education teachers are only required to enroll in one to two courses to meet certification requirements to teach agricultural mechanics (Hubert and Leising, 2000). If secondary agricultural education teachers are not adequately trained to teach agricultural mechanics, a disservice has been done to the next generation of students. The students will not be offered the opportunity to gain the same real-world experiences as their peers enrolled in agricultural mechanics courses taught by an adequately trained teacher.

Recommendations

Teacher education programs should continue to develop high quality agricultural mechanics coursework consistent with practitioners' needs. It is extremely important that secondary agricultural education teachers receive as much positive exposure to agricultural mechanics as possible in order to ensure they are comfortable teaching at the secondary level (Burris et al., 2005). Since it is known that correlations do not infer causation, further research should be conducted to determine if secondary agricultural education teachers who were required to complete several agricultural mechanics courses have the same view of quality of training at the University level. Since agricultural mechanics courses are taught in a variety of departments beyond agricultural education, further research should determine which college or department taught the agricultural mechanics courses. Agricultural education faculty tend to teach agricultural mechanics courses from a pedagogical approach while other departments may focus on content. Positive experiences help influence the decisions of secondary agricultural education teachers to pursue other opportunities and training (Fishbein & Ajzen, 1975; Fraze, Wingenbach, Rutherford, & Wolfskill, 2011). For this reason, further research should be completed to determine if prior experience, and/or positive experiences with agricultural mechanics have lead to secondary agricultural education teachers further training beyond the baccalaureate degree.

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Deconstructing Content Knowledge: Coping Strategies and their Underlying Influencers for Beginning Agriculture Teachers

Amber H. Rice, University of Missouri
Tracy Kitchel, University of Missouri

Introduction

Teachers' content knowledge and understanding of material is influential in their ability to break down content for students (Diakidoy & Iordanou, 2003). Specifically, teachers need to address student confusions, misconceptions, and respond to questions (Kennedy, 1998). Agriculture teachers must have breadth and depth of content knowledge (Barrick & Garton, 2010) to achieve these tasks. When preservice teachers engage in student teaching, they must be adept at using content expertise to generate explanations, representations, or clarifications for students (Shulman, 1986). This goes beyond tips and tricks for instructional strategies and delves into how students comprehend content (Van Driel & Berry, 2012).

Transforming content knowledge for student understanding is not an easy task. It requires critical interpretation, choosing specific instructional methods, and tailoring adaptations based on students' needs (Shulman, 1987). Beginning teachers often struggle to comprehend how this deconstruction of knowledge occurs and may demonstrate fewer knowledge bases necessary for teaching compared to expert teachers (Turner-Bissett, 1999). Examining agricultural education beginning teachers' processes of deconstructing content could aide teacher preparation programs in preparing preservice teachers.

Literature Review

Frameworks and literature surrounding pedagogical content knowledge (PCK) were examined. PCK refers to combination of content knowledge, instructional strategies incorporating content, and knowledge of students' learning (Van Driel, De Jong, & Verloop, 2002). PCK is crucial for deconstruction of knowledge. Teachers' actions in the classroom are greatly influenced by PCK, making it an essential part of their learning (Solis, 2009). Without a strong understanding of content, teachers will struggle to help students learn in meaningful ways (Ball & McDiarmid, 1990). However, it is more than just knowing content; it is applying content for student understanding.

A study of chemistry teachers' PCK, discovered teachers lacked theoretical arguments to promote student comprehension (Van Driel, Verloop, & DeVos, 1998). Preservice physics teachers had difficulty transforming content for students due to incorrect content knowledge and inability to predict and address misconceptions (Halim & Meerah, 2002). Problems persist beyond science education. In mathematics, teachers were unable to provide explanations for material that was relevant and on the students' level (Borko et al., 1992). With the broad scope of agricultural education, from biotechnology to mechanics, there may be a need for increased incorporation of content knowledge and its effective use into the teacher preparation curriculum. Science and math education fields are at the forefront of PCK research (Hashweh, 2005; Hill, Ball, & Schilling, 2008; Magnusson, Krajcik, & Borko, 1999; Mulhall, Berry & Loughran, 2003). Despite research being conducted in various disciplines (Ball, Thames, & Phelps, 2008) there has been little to no PCK research in agricultural education. Although agricultural education draws on science and math, the breadth includes other knowledge including leadership and communications (National Council for Agricultural Education, 2009). This breadth of content necessitates exploration into how agriculture teachers deconstruct content for student understanding.

Central Question

The central question aligns with the 2011-2015 National Research Agenda for agricultural education priority four, meaningful and engaged learning in all environments (Doerfert, 2011): What is the process beginning agriculture teachers go through when deconstructing their content knowledge for students?

Methods

This qualitative study utilized a grounded theory approach, which is appropriate for analyzing a process to describe what it is and discover how it works (Corbin & Strauss, 2008). Specifically, this study was guided by the work of Corbin and Strauss (2008).

Agriculture teachers with two to four years of classroom experience were recruited to focus on beginning teachers' development because five years is when expertise begins to be achieved (Darling-Hammond & Bransford, 2005). All teachers were purposefully graduates of the University of Missouri and had similar preparation. Thirteen teachers fit these requirements and were within 180 miles for fieldwork. Five teachers agreed to participate, two males and three females. One teacher was in a single teacher department; the rest were in multi-teacher departments. Four teachers were employed in rural school districts; one teacher was employed in a suburban school district. Due to variation of content in agriculture programs, we focused on lessons integrating science concepts.

First, data were collected using video-recorded classroom observations lasting 45-minutes. Second, field notes were taken during observations to capture reactions and interactions not on video. Third, one-on-one semi-structured interviews were conducted after observations. Questions evolved throughout the process to meet the needs of concepts being investigated (Corbin & Strauss, 2008). As data collection and analysis continued, teachers were contacted via e-mail for clarification and confirmation of information.

Field notes, video transcriptions, and interview transcriptions were used to form initial codes through open coding via NVivo 10 software. A constant comparative method was used to compare data against data (Corbin & Strauss, 2008). Categories were developed and collapsed into the final themes. Multiple models emerged and transformed throughout the process. To ensure trustworthiness, member checking was utilized (Creswell, 2013). Credibility was insured by richness of data obtained and reflexivity through memoing (Corbin & Strauss, 2008).

Findings
Content Knowledge Deficiency and Coping Strategies

The initial central question centered on beginning agriculture teachers' deconstruction of content knowledge. However, a pervasive theme emerged with the first teacher and continued with subsequent teachers. Because teachers viewed themselves as deficient in content knowledge, many of their deconstruction strategies were first filtered through an overall umbrella we termed *content knowledge deficiency*. Common teacher descriptions included: dreading being asked questions, feeling unable to explain "why" behind content, doubting effectiveness as a content teacher, and feeling like students were "smarter" in content. Due to implications this may have on future agriculture PCK studies, we made the decision to explore how beginning teachers were coping with this self-perceived content knowledge deficiency and its effect on the teaching process.

When agriculture teachers felt content deficient, it influenced their decisions during planning and in-the-moment teaching stages (see Figure 1). Professional development workshops, seeking help from teachers, and researching on their own were all viewed as viable ways to compensate for content knowledge deficiency during planning. Sometimes, teachers were unable to plan for content knowledge deficiencies and reacted in-the-moment. Prevalent in-the-moment coping strategies included: admitting they didn't know, referencing what they know, and encouraging students to learn on their own. Seeking help from students, researching as a class, and avoiding content they didn't know emerged as strategies during both stages.

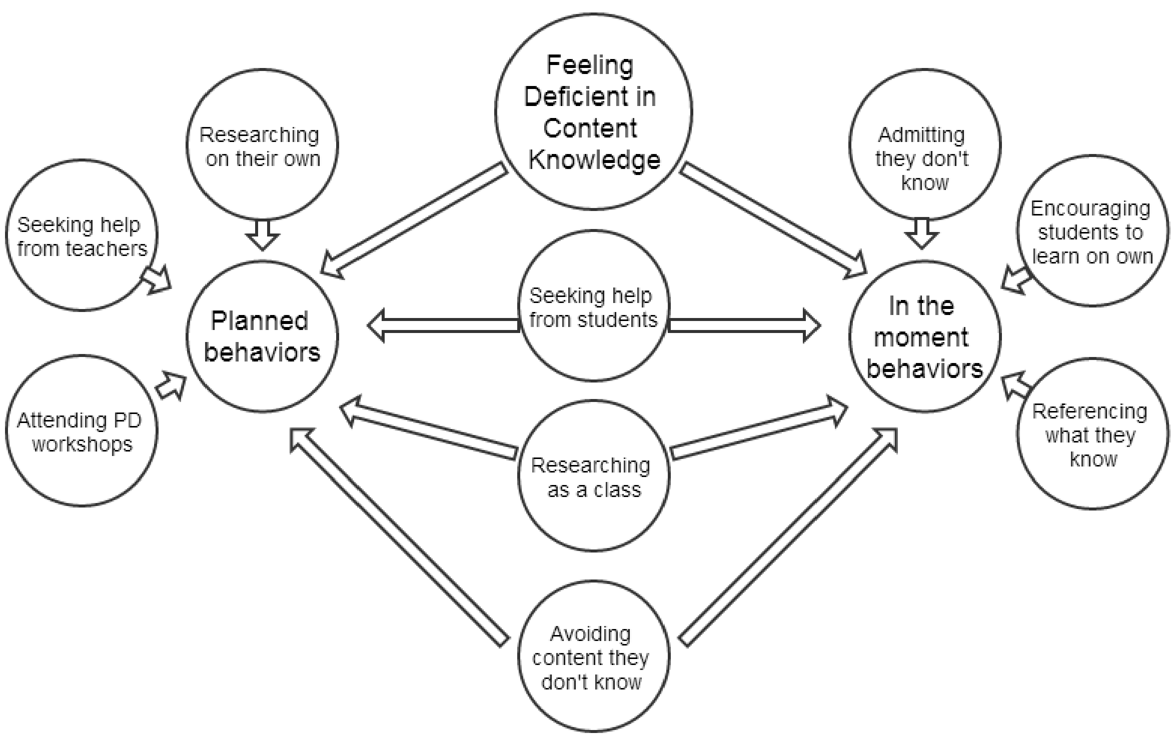

Figure 1. Coping strategies when teachers felt deficient in content knowledge

Underlying Influencers of Coping Strategies

There were a variety of underlying influencers affecting type and frequency of strategies teachers used when they felt content deficient. These influencers included external circumstances of the teachers' school environment and internal circumstances including teachers' perceived credibility, interest in content, and philosophies about the purpose of agricultural education (see Figure 2).

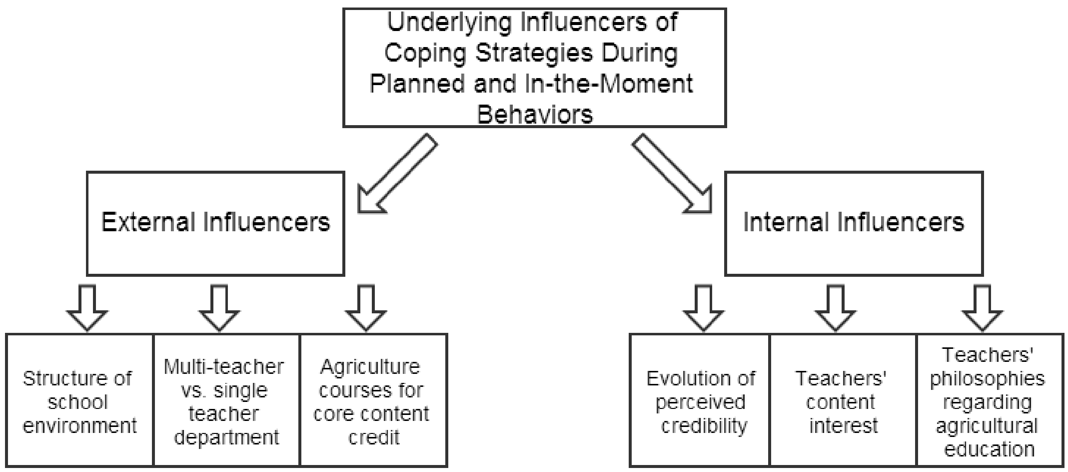

Figure 2. Underlying external and internal influencers of coping strategies

External Influencers

Underlying influencers were often related to the school environment and included: time, funding, and technology. Teachers identified time constraints including amount of time to plan, amount of time in a class period, and amount of time in a course. Attending professional development workshops was mentioned as a way to cope with content knowledge deficiencies; however, time and cost were identified as barriers. Melissa described the influence of technology availability on her teaching. Schools with readily accessible technology made it easier for teachers to assign research projects and use in-the-moment strategies.

The type of department, multi-teacher or single-teacher, also impacted coping strategies. If other teachers in the department were more experienced in content, beginning teachers often chose strategies congruent with seeking out additional knowledge to keep up with colleagues. Due to the autonomy many agriculture teachers have within programs, teachers often taught and referenced what they already knew or left out content which they were uncomfortable. Single-teacher Melissa claimed she was likely to avoid unfamiliar content because "no one would know." Overall, belonging to a multi-teacher department influenced beginning teachers to choose more coping strategies during planning due to colleague accountability and inability to hide knowledge deficiency.

Accountability for content in that school environment also influenced how a teacher coped with content knowledge deficiency. In particular, teachers who offered a class for science credit tended to collaborate with science teachers and indicated increased pressure to learn content.

Additionally, if schools required certain classes or content to be taught, teachers had to operate within those constraints. When specific courses were inherited, teachers were more likely to seek out additional knowledge during planning if they felt content deficient.

Internal Influencers

Teachers often felt their inability to answer questions hurt their credibility with students. This desire to prove credibility led teachers to seek strategies during planning involving new knowledge acquisition. When admitting they did not know, teachers often placed the responsibility of knowledge acquisition on the class as a whole or the individual student asking the question. Pressure to prove credibility seemed to dissipate over time, allowing teachers more comfort in admitting a lack of knowledge.

Interest in content also influenced teachers' choice of coping strategies. If teachers were not internally motivated to spend time learning content they were likely to encourage students to learn on their own, research as a class, or avoid content which they lacked interest. Passion for a subject made it is easier to spend time reading or planning. Melissa said she would probably gloss over a lot of content not peaking her interest by using this strategy, "let's look this up or do a two week unit on it at the end of the semester."

Teacher philosophies about the purpose of agricultural education played a role in how they coped with content knowledge deficiency. If utility for student learning was agricultural literacy, teachers were less likely to use coping strategies during planning. Research groups were a more viable option for exploring agriculture topics versus mastering traditional career preparatory skills. When I discussed goals of student learning most teachers responded with an agricultural literacy focus so it could "apply to their everyday lives", but imbedded in conversations was also a need for students to develop career preparatory skills, demonstrating internal conflict about the purpose of agricultural education.

Discussion

There appeared to be a struggle for teachers between balancing external and internal influencers. With 81% of teachers reporting at least two computers in the classroom or access to computer labs, teachers can abdicate their role as the primary source of knowledge. Researching in groups and individual learning has become more of the norm; over half of teachers reported frequent use of technology for instruction (United States Department of Education, 2003). This can lead to relying on class-wide research or individual learning instead of teachers seeking out additional knowledge. For some teachers, they felt like a true expert teacher is one who can lecture and lead discussion. These teachers often felt compelled to seek out additional knowledge during planning, but may be restricted by time or funding.

Making professional development opportunities for agriculture teachers more accessible could help alleviate problems related to time and funding. Also, many teachers discussed feeling inadequately prepared in content from their teacher preparation programs, which echoes findings of Ballantyne and Packer (2004), Borko et al. (1992), and Haston and Leon-Guerreo (2008). Investigation and conversation about the role of teacher preparation seems worth the time and resources, including exploration into the possibility of specialization areas for specific agriculture content.

The debate over the purpose agricultural education (agricultural literacy or career-readiness) is not new (Roberts & Ball, 2009). Teachers expressed conflicting philosophies about the purpose of agriculture programs. Teacher preparation programs should be consistent regarding messages they are sending about the purpose of agricultural education, so teachers can have a clear vision for preparation of students. Programs with an agricultural literacy focus will look different from career preparatory focused programs.

Recommendations from this study included a more in-depth exploration into the impact of teachers' philosophies regarding agricultural education related orientation and the role of beliefs on teachers' PCK (Hashweh, 2005; Magnusson et al. 1999). Additionally, investigating experienced agriculture teachers could provide insight into the emergence of PCK as beginning agriculture teachers become experts. Finally, research on the connection between teachers avoiding content and student achievement should be conducted.

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Application of Social Network Analysis (SNA) in Cooperative Extension: Understanding Diversity and Reach of Cooperative Extension in Communities

Anil Kumar Chaudhary, the Pennsylvania State University
Rama Radhakrishna, the Pennsylvania State University

Introduction/Conceptual Framework

Extension has a long history of delivering programs to clientele. In the last 100 years, Cooperative Extension System (CES) has gained the reputation of most effective technology diffusion organization along with largest non-formal adult education organization in the world (Franz & Towson, 2008; Rogers, 1992).

CES in land grant universities functions through offering various non-formal, non-credit educational programs in agricultural crop production, economic and community development, animal production, family and consumer sciences, 4-H and youth development, nutrition, diet and health and conservation of environment and natural resources (Franz & Townson,2008; NIFA, n.d.).

Over the past few decades there has been a shift in demographics in suburban and urban areas across the US and in [state] which led to fewer population staying in rural areas and less than 2% of population engaged in agriculture (Franz & Townson, 2008; Peters & Franz, 2012). In addition, there have been deep budget cuts, complex accountability and staffing structures, widely varying programs and delivery methods had put the CES in a defensive position (Calvin, 2012; Franz & Townson, 2008; Peters & Franz, 2012; Ilvento, 2008).

CES has to embrace the use of technology to their routine activities in order to do more with limited resources, reach large number of audiences, serve the new audiences and showcase the public value of its programs to stakeholders through new program evaluation methods such as Social Network Analysis (SNA).

Social Network Analysis (SNA) is a methodology which provides complementary visual and statistical components for analyzing the traits of actors and their relationships in a network. Brass, Galaskiewicz, Greve & Tsai (2004) defined network "as a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes" (p. 795). Where nodes are the actors like individuals, groups, subunits, and organizations and ties are the relationships between these various actors. According to network perspective, actors are embedded within the network of interconnected relationships which provides both opportunities and constraints on the behavior of actors (Brass et al., 2004; Kilduff & Tsai, 2003).

SNA methodology has been widely utilized in disciplines such as sociology, business management and public health for understanding various individual or organizational outcomes (Springer & De Steiguer, 2011). However, this methodology is still underused in agricultural and extension education and literature on SNA use is scarce. Bartholomay, Chazdon, Marczak and Walker (2011) conducted a study to examine the outreach of University of Minnesota (UM) Extension to organizations outside UM. They utilized SNA as a methodology to understand the outreach of UM. They found that outreach network of UM Extension were both broad in its reach and strong in its connection. They concluded that SNA has the great potential to describe and understand the Extension outreach. Springer and De Steiguer (2011) also concluded that SNA has much to offer for Extension professionals and specifically the visual and statistical elements in SNA.

With the Penn State University Core Council's recommendations for improvement in organization and operation of the College of Agricultural Sciences and Cooperative Extension and budget cuts for Cooperative Extension in FY2011-12, Penn State Cooperative Extension underwent restructuring in 2011, where in Penn State Cooperative Extension adopted a new "business model" to improve its visibility in communities in Pennsylvania as a one organization offering different educational programs to address societal issues rather than known by varied education programs such as 4-H and Master Gardner's (Calvin, 2012).

Three years have passed since the implementation of the new business model, but no efforts have been made to understand the reach and networks of new Penn State Cooperative Extension programs across Pennsylvania and how successful Penn State Cooperative Extension is in adaptation of its new business model, to current funding requirements and in addressing the issues faced by the citizens of Pennsylvania.

Purpose and Objective:

The purpose of this study was to understand the diversity and reach of Cooperative Extension programs in Pennsylvania delivered by Penn State Extension through Social Network Analysis (SNA). Specific objective of the study was to:
Develop whole network map of programs and their stakeholders to understand the diversity and reach of Extension programs in Pennsylvania.

Methodology

This research was conducted with the cooperation of Penn State Extension, the outreach component of the College of Agricultural Sciences at the Pennsylvania State University. The population for this study consisted of all the programs offered by Penn State Extension and the respective stakeholders. The sampling method used for this study was a 'census' meaning all the programs and the respective stakeholders were used for this study. The study utilized SNA methodology.

Data for study were collected for various programs offered by Penn State Extension and the program stakeholders from all seven State Program Leaders (SPLs), 48 State Extension Team Leaders (SETLs) and the director of Penn State Extension through an electronic questionnaire using SurveyMonkey. Data from a list of programs and program stakeholders was input to UCINET 6; a user-friendly SNA package for analysis of social network data (Borgatti, Everett, & Freeman, 2002). Based on two mode matrix of programs and their stakeholders, the complete network map of programs and the stakeholders was drawn using Netdraw's spring embedding algorithm (Borgatti, 2002). Using network maps, characteristics of PSE network were also described.

Results

Network maps are a very powerful empirical tool to reveal the outreach of any organization in the community (Bartholomay et al., 2011). These network maps not only reveal the outreach of organization but also exhibit which programs have the common stakeholders. The complete network map of Penn State Extension drawn with NetDraw's spring embedding algorithm revealed the following (the green circles represents the programs and blue circles represents the stakeholders and arrows in pink represent the connection between the program and stakeholders) (See Figure 1):

- In all Penn State Extension network consists of 60 programs and 299 stakeholders; one program was associated to multiple stakeholders, with a maximum of 52 stakeholders associated to livestock production efficiency program and a minimum associated with to farm transitions program (5). On an average, each program was associated to 19.18 stakeholders (SD=9.80).

- The Penn State Extension network was widely distributed and had the wide reach among the stakeholders. Overall the network was segmented indicating a clear division in the network which was divided into two halves. The right side of network division consist of animal related and renewable natural resources programs while the left side consist of programs related to plants and safety and health management of consumers (See Figure 1).

- Upon further analysis of the network, one can see that complete network was divided into four clusters, named A, B, C, and D. Cluster A included programs related to veterinary, dairy, cluster B consisted of programs related to plants science mainly horticulture and field crops production, cluster C included programs mainly related to food safety and health of consumers; and finally the cluster D consisted of programs related to renewable natural resources and economic and community development. The programs in each cluster have more number of stakeholders in common compared to other programs (See Figure 1).

- The programs which were located at the center of the network and not associated to any cluster were managing community and urban natural resources and ag business management.

- Some programs were isolated from network such as programs related to food safety, 4-H and youth development, equine health and wellbeing and livestock production efficiency, indicates that these programs have specific stakeholders (See Figure 1).

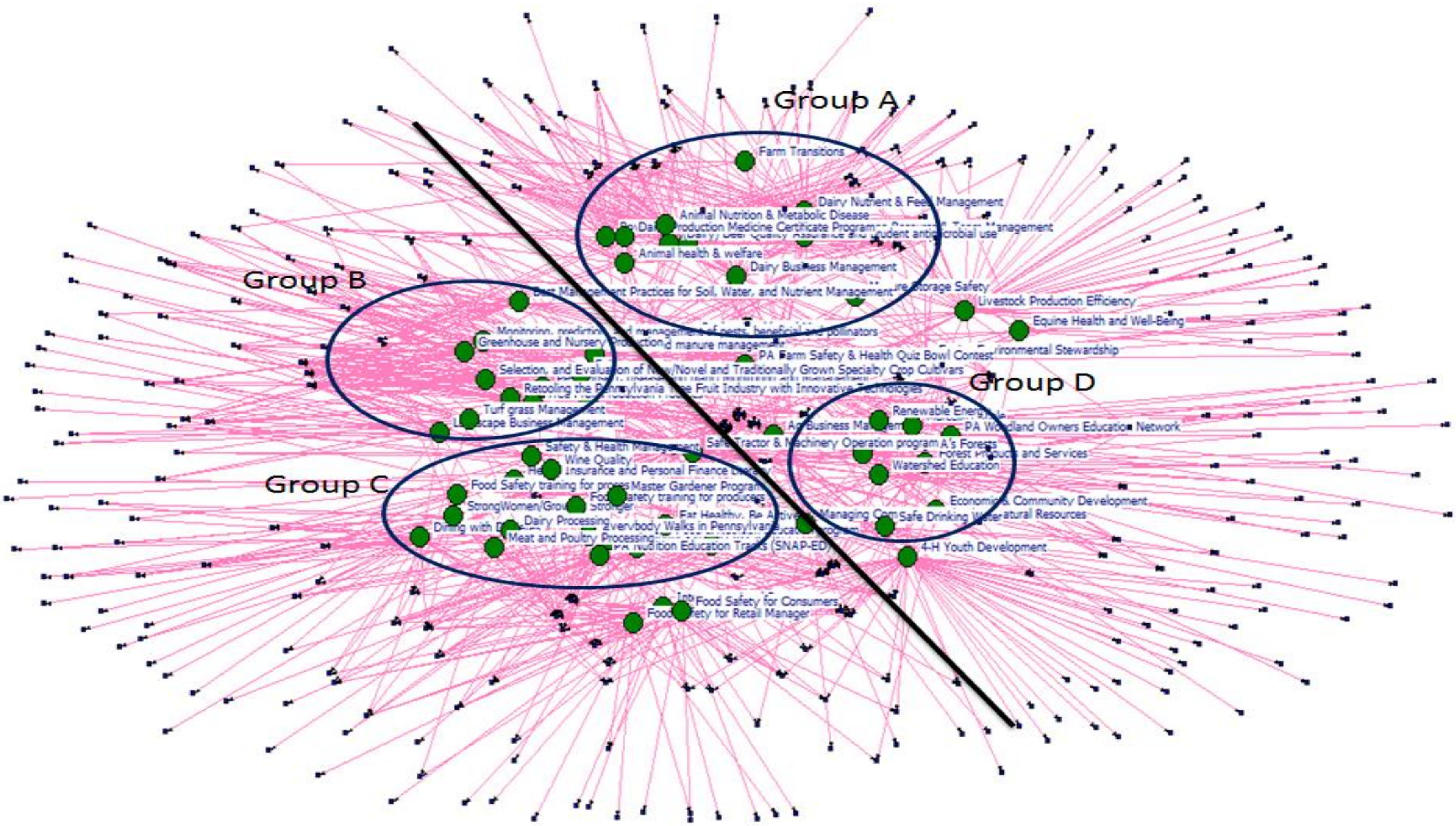

Figure 1. Overall Network of Penn State Extension (Programs and their Stakeholders)

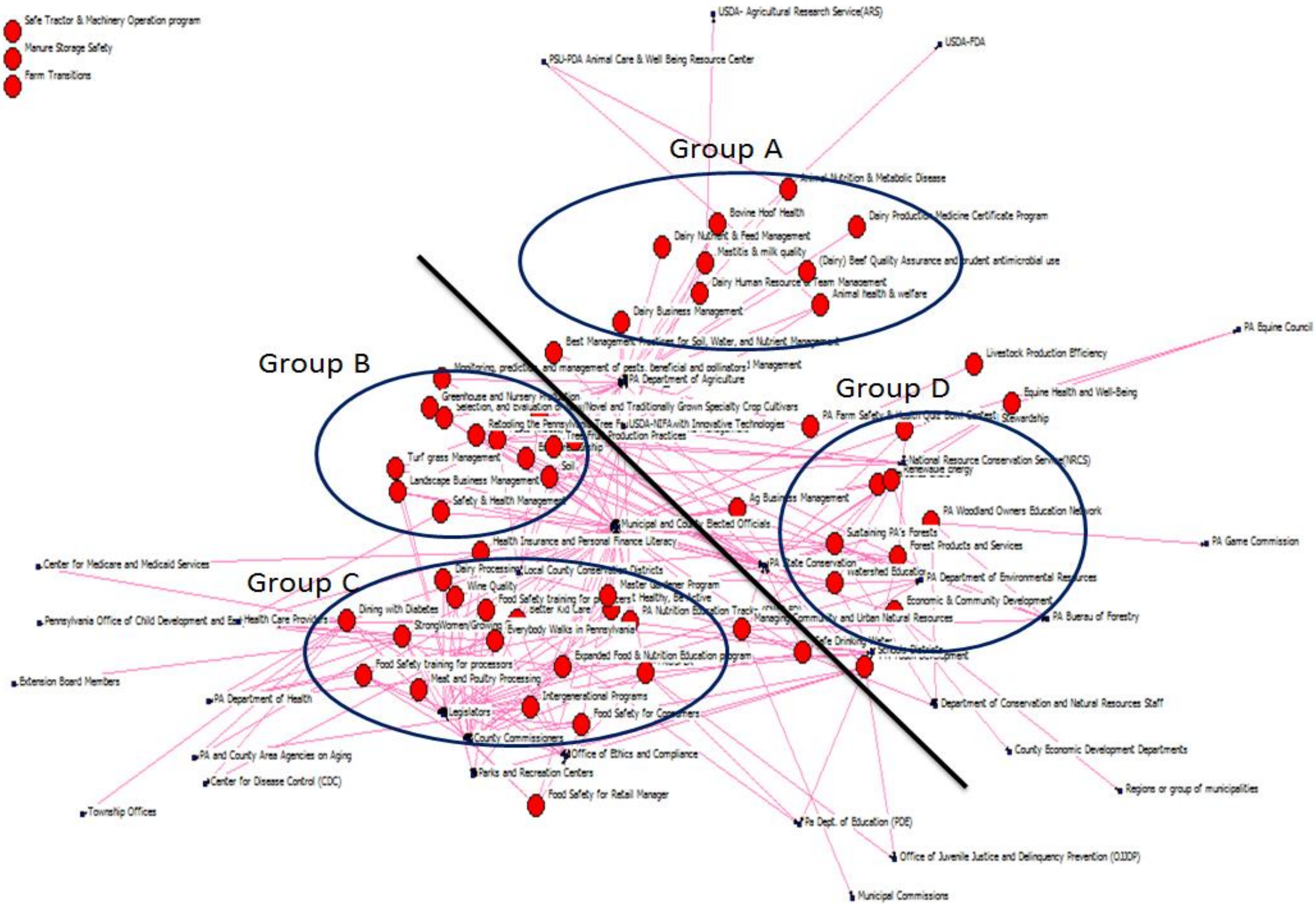

Figure 2. Overall Network of Penn State Extension (Programs and their Government Stakeholders)

For in depth understanding of the networks of Penn State Extension, the network was further simplified into network of programs and the government stakeholders. As a result there were 33 government stakeholders. Overall, programs were well connected to government stakeholders indicating that programs were receiving knowledge and information from local, state and federal governments. Similar to the whole network, this network also had the four clusters, with few isolates (farm transitions, manure storage safety and safe tractor and machinery operation programs) which were not connected to any stakeholders (See Figure 2).

The Penn State Extension networks were also analyzed by segregating the programs into 12 teams and then drawing the network of teams and stakeholders. The red circles represent the teams and very small blue circles represent the stakeholders. The teams were represented with different circle sizes, where bigger size indicating the more number of connections that teams have with the stakeholders. The map reveals the following (See Figure 3):

- Teams to stakeholder's network were very widespread, and therefore were well connected to various stakeholders.
- Similar to programs to stakeholder's network, this network (teams) was also clearly divided into two parts.
- Further analysis of this network exhibits two clusters A and B. Cluster A consisted of all animal related teams while cluster B contained all plant and natural resources related teams.
- Some teams were isolates, such a 4-H and youth development, livestock which indicates that they had specialized stakeholders (See Figure 3).

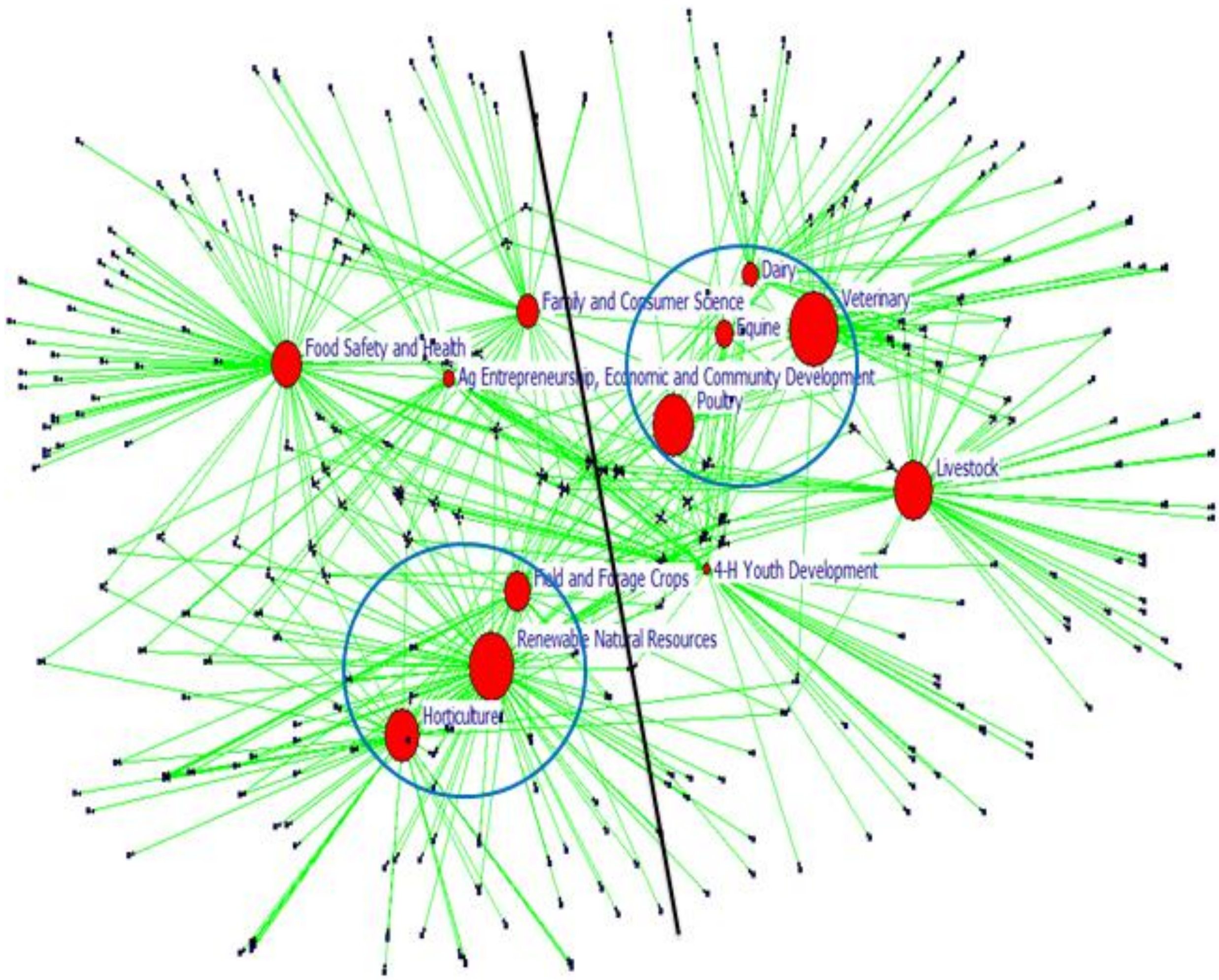

Figure 3. Overall Network of Penn State Extension (Teams and their Stakeholders)

Conclusions

Analyzing the network maps of programs and their stakeholders, it is concluded that the Penn State Extension network is widely distributed and has extensive reach in the community by connections to various stakeholders and more number of stakeholders associated to each program. The network consists of some clusters, and in examining the clusters it is concluded that programs in these clusters have more in common and efforts should be made for greater collaboration between programs in each cluster that may be lacking in the current network. The presence of some isolates in the network suggests that they have niche areas and are less connected to stakeholders of other programs because of their distinctiveness in their goals and objectives or unique program areas. Similar conclusions are made for programs to government stakeholders. However, for isolates, efforts should be made to increase their connections to government agencies which may ultimately contribute to their better performance through receiving more funds and new information.

The teams and stakeholder's network are also very much consistent with programs and stakeholder's network. Similar conclusions were drawn as for programs and stakeholder's network.

Overall it can be concluded that, SNA has much to offer in order to understand the outreach of Extension and in understanding various outcomes for Extension programs. The work of Extension is largely dependent on the relationship with stakeholders, so SNA should be frequently utilized by Extension to understand the dynamic outreach network to better serve target audiences. Overall, SNA information will be important in the future as Extension looks for alternative ways to utilize the limited resources more efficiently.

The conclusions of Bartholomay et al. (2011) and Springer & de Steiguer (2011) support the conclusion from the current study that SNA provides valuable information for understanding Extension outreach and various outcomes for Extension programs and for identification of greater internal collaboration among programs.

Recommendations and Implications

- The results of the study should be communicated with Penn State Extension system for better collaboration among programs in the time of tight funding and scarce resources.

- Administrators should encourage the collaboration among programs such as joint grant writing, conducting programs together where there are common stakeholders considering the various clusters found in the study.

- Extension professionals have to use the new methods of evaluation, such as SNA, which provides a clear picture about reach of Extension among stakeholders. Networks have to be analyzed at regular intervals to assess the change in networks to improve the internal collaboration and information and resources shared among programs in order to better serve the communities and address the issues facing society more efficiently.

- SNA should be utilized in Extension in order to understand the stakeholder's segmentation (sharing the common interests and needs), that will help in delivering right programs to right audiences with fair chances of change in behavior of participants.

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Agricultural Education for All: Expansion Techniques at the Secondary Level

Kendall M. Wright
Magoffin County High School

Stacy K. Vincent
University of Kentucky

The Need

For secondary students, productive dispositions and behaviors, coupled with non-cognitive skills, are most predictive of future earnings (Lerman, 2008). Therefore, state education departments are directing their emphasis on college and career ready models. A number of educational organizations agree that all students should be college and career ready (Darch & Stam, 2012). In a 2011 study, 27 states were in the process of developing common assessments that align with Core State Standards (Rumberger); of which are designed to measure career and college readiness in secondary students (McIntosh, 2010).

Career development courses provide opportunities for a variety of learners in underserved populations to excel and succeed in educational settings (Herrick, 2010). According to Roberts (2009), new agriculture programs in Texas schools allowed Latino students to become more active in their education by joining and participating in an intra-curricular program. Parents and alumni from the area became active in students' education. Increased engagements in and out of the classroom, as found in agricultural education, are correlated to a reduction in disciplinary referrals (Fowler, 2011).

Students can benefit from completing a course in career and technical education. Hagen (2010) conducted a study where one high school policy required all students enroll in career and technical educatione every year. His findings revealed an improvement in student engagement, achievement, self-confidence, competence, transition, attendance, dropout, and graduation. In return, students experienced a higher level of motivation (Eggen & Kauchak, 2010). Similarly, students in agriculture courses demonstrated a higher need for achievement than power (Herren & Turner, 1997). Furthermore, research indicates students enrolled in career and technical education demonstrate higher levels of engagement, leading to reduction in dropout probability (Kotamraju, 2007).

The Theory

According to Rogers' Diffusion of Innovations Theory (2003), an innovation is adopted after a need is determined. Specific components must be present during the innovative process of adopting a solution to the need. These five components are: motivation, advocacy, innovation, community rejuvenation, and program regeneration. Once these five areas are established, the innovation can be determined, as was the case for Brown and Kelsey (2012) when exploring methods of improving urban agricultural education. The Diffusion of Innovations theory describes the necessary means for an innovation to be adopted by a particular group of people. An innovation is a new idea, product, or method as perceived by an individual or group of people

(Rogers, 1983). Rogers believed diffusion was a process where innovation is communicated through various methods over time among the members of a social system.

The Process

The purpose of this qualitative case study was to describe effective methods for establishing agricultural education programs. This was a multiple case study, qualitative in nature, as designed by Denzin and Lincoln (2008) and Creswell (2009). The researchers sought to obtain a series of phenomena, common in different states about the methods for establishing new agricultural education programs. The researchers took a pragmatic approach to gather facts and then draw conclusions. This study closely follows Rogers's (1983) theory.

The National Association for Agricultural Education could not provide an accurate count of agricultural education programs; therefore, FFA chapters, provided by National FFA Organization, served as a frame reference point. Over the last seven years, the nation had an average increase of 12.6 programs per state, with 67% of that growth coming from ten states, of which were selected for this study. The longest tenured staff member in the state's department and/or considered leader in the state's growth served as participants.

Because of limited experience with program development, formal interview protocol was used. Interview questions were structured and centered on each state's method and implementation of new secondary programs. The initial one-hour interview was an audio-recorded phone conversation. Throughout the interviews, notes of reactions were maintained in a reflective journal. Follow-up phone calls were conducted to verify content from the interview.

Peer debriefing was utilized from outside sources throughout data collection and coding. Inter-rater reliability was established, thus enhancing thematic credibility (Saldeña, 2009). To increase trustworthiness, participants were given a copy of the findings and confirmed the results, creating data confirmability. Credibility of the data was established through the use of reference materials, peer debriefing, and member checking. To add multiple perceptions to the analysis of the data for the enhancement of credibility, triangulation was utilized throughout the procedures. Thematic responses were axial coded following Roger's theory to develop assertions based on intuition (Smith, 1978). A reflective journal was maintained to describe interactions and to note any biases. For confidentiality, participants were given alias names

Findings

Identify stakeholders 

Throughout the interviews, participants emphasized the importance of identifying stakeholder. These stakeholders served as connectors with voting members of the local board of education. In each of the interviews, it was described that these stakeholders could bring the development of an agricultural education program for consideration more so than outside sources. In fact, Mr. C stated, "If the demand is coming from their local community leaders, they listen much better than from the state level." Three different subgroups of stakeholders emerged: community citizens, school officials, and agriculture community leaders/organizations. The community citizen consisted of parents, students, alumni, to legislators. The participants believed these individuals were crucial in selling the need for a program.

The second group, school officials, ranged from administrators, school board members, and superintendents. A school administrator wants a program that appeals to students, parents, and addresses academic achievement on state mandated assessments. Every state had a different method of reaching school administrators. Some had methods for connecting agriculture student academic results in comparison to other students. At the same time, some states took a more hands-on approach by investing time and resources to the National FFA Convention in order to see the product of students within the career development events.

The third group included leaders/organizations in the agriculture community, such as farmers, civic groups, and agribusinesses. These stakeholders have a different set of needs from an agricultural education program and see how it benefits them. In addition, agriculture community leaders/organizations expose decision makers how relevant the agriculture industry is to the local community. Mr. A assisted this concept by saying, "The local Farm Bureau and Grange are wonderful partners. With those great relationships, we can inspire and influence local people to make decisions to consider starting an agricultural education program and see how it benefits their community, state, and global economy and workforce."

Communication as a method of entry 

An important part of building relationships with stakeholders is communication. In each interview, methods of communication continued to emerge as a factor in creating new programs. Participants overwhelmingly believed that face-to-face meetings were the most effective methods of communication. Yet, participants recognized the need for other methods of communication, such as email, web-based information, and conference calls. Several documents and online resources were utilized in order to implement new programs. These resources include student surveys; educational literature about agriculture and agricultural education; course standards; websites with information about agriculture courses; and letters. Additional resources mentioned include grants for new programs, use of state officer visits, and state staff designated to help and provide assistance to a region of teachers.

Overcoming agricultural education illiteracy 

In order to begin new programs, educators and administrators must see value in agriculture to develop a need for an agricultural education program. To explain, Mr. G stated, "An obstacle is administrators and parents not understanding what is involved in agricultural education and thinking its students going into farming. So it becomes a process to educate that we are preparing students to go into a broad field of agriculture." The participants discussed their first task in beginning new programs was to establish validity and importance for agriculture. Several participants spoke about schools wanting an FFA chapter, but unaware they had to have an agricultural education program first. In return, this led the researchers noting some of the best "sales pitches" in addressing these initial concerns. With tact the participants had found a way to connect agricultural education to the economics and not production agriculture. Due to how passionate many of their responses were, a follow-up question later asked if bringing light to the opportunities in the agricultural industry was a common approach to addressing illiteracy. In each correspondence back, the participant answered, "Yes".

Addressing financial support 

Participants continued to report having to overcome a funding deficiency for establishin new agricultural education programs. In most states, agriculture teachers are provided an extended contract (Dyer & Williams, 1997). In addition to paying a higher salary to a teacher, agricultural programs require additional facilities. With financial burdens and an economic recession, these states continue to persevere. Nonetheless, participants found methods to address financial concerns that districts and schools have. Mr. C breaks down economics in order to help administrators see the benefits, “We actually generate more dollars per student than academic programs.” and then he followed the statement by sending the researchers with specific economic data of students, federal money spent, and the correlation of earned taxable income back into the community. Mr. G follows a similar approach and as a result noticed school districts investing in the startup of an agriculture program while cutting funds – “I witnessed a board meeting where the district cut $400,000 from their budget, and then right after they did that, they added an ag program.”

Discussion

No program is the same and will not be created and implemented in the exact way, but similarities exist in the diffusion process. From this study, it was concluded that one of the first steps in creating new programs is to identify the needs of all stakeholders, including the community members, school officials, and industry representatives. Another important part of the process is to use the most effective communication channels possible.

The need for stakeholders serves as adapters to Rogers (1983) theory. These stakeholders are salespersons for promoting the start of agricultural education programs. Organizations serve as fundamental opportunities for community members to encourage the promotion of a secondary program within a school. To begin the process of innovation, agricultural education state staff and teacher educators who are looking for adapters should consider meeting with various advocate groups that could assist in the process. Examples of organizations to be contacted are the American Farm Bureau, the National Association of Secondary Principals, and the United States Chamber of Commerce.

If support for agricultural education could be raised in school systems that do not currently have programs, they would be more likely to implement one. Therefore, it is recommended that advocates for agricultural education programs target school administrators to encourage implementation through face-to-face meetings. In addition, different resources, such as community, financial, industrial, and collegial are beneficial if established prior to meeting. The establishment of such resources addresses barriers that may limit the social system (Rogers, 1983).

It was concluded that the development of a new program is costly and such cost may sometimes be detrimental to its development. Therefore, it is recommended that supporters of agricultural education lobby with state legislatures to develop funding for the program establishment. Such funding sources assist in addressing barriers and further securing a commitment between the administration and agricultural education stakeholders.

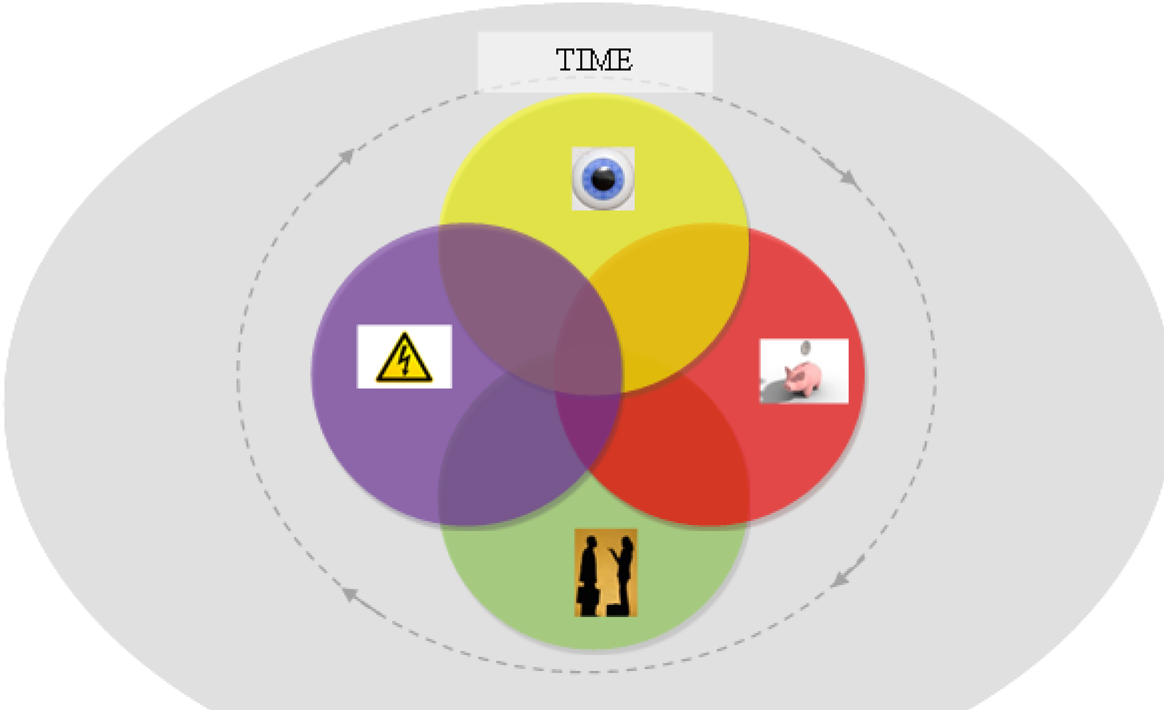

Figure 1: Agricultural Education Program Development Concept Model

To assist in understanding the emerging themes, the researchers developed the agricultural education program development concept model (Figure 1). It is important to note that this model is merely a visual representation of how the researchers in this study conceptualize program expansion. The model best represents what the participants conceptualized for their success in program expansion. Each of the four emerging themes are linked together in the program expansion process. Although time is necessary in the development of a new program, stakeholders must be involved, funding sources need to be addressed, a clear and open flow of communication has to exist, and the school or profession must identify and extinguish educational barriers. It is recommended that the model serve as a guide toward further exploration and validation of the findings.

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Extension and Research Faculty Perspectives of Extension-Research Integration: Challenges and Opportunities

Anil Kumar Chaudhary, the Pennsylvania State University
Rama Radhakrishna, the Pennsylvania State University

Introduction/Conceptual Framework

Extension and research, even after having the diverse organizational and cultural identities, tried to work together over decades as they were tied together by common land grant mission (Bennett, 2000). In the era of deep budget cuts, complex accountability and staffing structures (Peters & Franz, 2012), unification of Extension and research is imperative. Further, to address critical issues facing society in a coherent way, land grant universities must emphasize integrated research and education activities (Kellogg Commission Report, 1999).

According to Hamilton, Chen, Pillemer & Meador (2013), Extension educators have been considered experts in taking the latest university-generated research and making it available to stakeholders in the form of science-based information and educational programs. Further, problems faced by farmers and the general public relative to a new technology or practice would be conveyed to the researchers and laboratories so that corrections could be made to the new technologies. A number of research faculty, Extension specialists, and administrators (Warner, Hinrichs, Schneyer &Joyce 1998; Gorsuch, 1999; Decker, 2004; Gould & Ham, 2002; Bitsch & Thornsbury, 2010; and Hamilton et al. 2013) have examined issues and concerns relative to Extension-research (E-R) integration activities. Consensus from these studies suggests varying views of E-R integration.

E-R integration efforts occur throughout the land grant system (Gould & Ham, 2002). In their study of directors of Agricultural and Experiment Stations (AES) and Cooperative Extension System (CES), Gould and Ham found that 86% of the directors indicated that enhancing collaborative efforts between AES and CES was a concern. The directors identified several barriers to E-R integration which included: lack of funding sources, different expectations from different faculty, different reporting for Extension and research faculty and lack of proper administrative support. Suggestions to strengthen E-R integration were: a strategic plan/vision to enhance collaboration, funding opportunities, engagement of Extension scientists in applied research, need of proposals to stimulate E-R integration, and incentive to enhance E-R integration.

As years passed, the success of integration efforts between Extension and research has been questioned by faculty, researchers, program leaders, administrators, planners, and government, at both federal and state levels. Are there substantial benefits to joint research-extension work? If yes, then what do research and extension faculty identify as benefits? Answers to these questions will help better understand the current status of integrated extension and research efforts and provide future directions for planning and assessing impact of integrated efforts.

Purpose and Objectives

The overall purpose of this study was to describe the current status of Extension-research (E-R) integration as perceived by Extension and research faculty. The specific objectives of the study were to:

1) Determine the perceptions of Extension and research faculty regarding integration activities;
2) Ascertain the roles of Extension and research faculty in E-R integration activities;
3) Identify barriers to E-R integration activities; and
4) Determine strategies for strengthening E-R integration activities

Methods

Study Design and Population

This study used a descriptive, cross sectional survey design. The data for this study came from a larger Agricultural Experimentation project in the College of Agricultural Sciences (CAS) at the Pennsylvania State University.

The target population consisted of all faculty with split appointments of 50% or greater Extension and research in CAS at the Pennsylvania State University. The frame was obtained from the records maintained in the Human Resources Office. The frame was verified by the department heads/unit leaders in the CAS to make sure that the appointment splits were accurate. As a result of this procedure, a total of 59 faculty with joint Extension and research appointments were identified as subjects for the study.

Instrumentation

A five-section instrument was developed to collect data. The questions in the instrument were based on the results of focus group interviews conducted earlier with select extension and research faculty (Radhakrishna, Tobin, & Foley, 2014). Four themes that emerged from the focus groups formed the basis for the questions/statements included in this instrument. The themes were: current status of integration activities, 2) understanding of Extension and research faculty roles, 3) barriers to integration, and 4) strategies for strengthening E-R integration activities. Section one contained 19 statements relative to the perceptions of current status of E-R integration activities, while section two contained 18 statements relative to understanding of roles of Extension and research faculty. Statements in sections one and two were measured on a five-point, Likert scale that ranged from 1=strongly disagree to 5=strongly agree. Section three contained 16 statements regarding barriers to E-R activities, measured on four-point scale that ranged from 1 = not at all a barrier to 4 = very much a barrier. Section four contained 22 statements regarding strategies to strengthen to E-R integration activities, measured on a five point, Likert scale that ranged from 1= strongly disagree to 5=strongly agree. The final section of the instrument elicited demographic information such as gender, education level, major area, previous appointments in Extension and/or research, degree granting institution (land grant or non- land grant) for the highest degree received and years in current position.

Face and content validity of the instrument was established through review of an expert panel of faculty with Extension and research appointments, staff and graduate students working in research projects and Extension programs. Research and Extension faculty who participated in the focus group interviews were not considered to review the instrument. After incorporating all the suggestions made by the expert panel, a pilot test was conducted. Cronbach's alphas for the first four sections of the instrument were found to be acceptable (alphas ranged from a low of .64 to a high of .88). The study was approved by the Institutional Review Board of the Penn State University

Data Collection and Analysis

The revised instrument was uploaded into SurveyMonkey for data collection. Dillman's total design method was used to collect data (Dillman, 2000). An initial pre-notification e-mail with consent form was sent to all 59 faculty. In all, three reminders were sent to all those who did not respond to initial and subsequent reminders. A total of 37 faculty responded for a return rate of 62.7%. Non-response error was addressed by comparing early, late and non-respondents as per procedures suggested by Miller and Smith (1983). Descriptive statistics including frequencies, percentages, means and standard deviations were calculated to summarize the data as appropriate.

Findings

Demographic Profile of Faculty

Out of those 37 faculty who responded to the survey, 23(62%) were male, 14 (38%) were female. Almost all of them reported their highest educational level as a doctorate degree from Land Grant Universities. The major for their doctorate degrees represented most disciplines in the Agricultural Sciences ranging from agriculture and extension education, plant pathology, vegetable crops, soil science, animal science, food science etc. Close to one- half (49%) were Extension specialists, 40% were research scientists, while 11% did not provide information on their appointment types. With respect to experience in their current positions, faculty averaged 17.8 years with a low of 0.5 years and a high of 45 years.

Objective 1: Faculty Perceptions

Faculty either 'agreed" or "strongly agreed" that joint appointments in research and Extension promotes integration (M=4.58, SD=0.60); research has become more important at the university level, compared to Extension (M=4.47, SD=0.74); conversations between Extension and research could create new insights to address critical issues facing society (M=4.28, SD=0.57); interdisciplinary collaboration efforts between Extension and research are occurring (M=4.14, SD=0.59); and Extension has a good record of extending university-based knowledge to clientele (M=4.11, SD=0.85).

Objective 2: Understanding Faculty Roles

Both groups of faculty "agreed" that they understood the roles of Extension and research faculty in university settings. The top three statements that both faculty groups agreed were:

extension serves as a link between the university and the public (*M*=4.38, *SD*=0.69); capitalizing on each other's role will strengthen integration efforts (*M*=4.24, *SD*=0.74); research faculty often have limited understanding of the role of Extension (*M*=4.23, *SD*=0.96). However, faculty “disagreed” with the statement, Extension faculty have limited understanding of the research process (*M*=1.82, *SD*==1.03).

Objective 3: Barriers

Both groups of faculty perceived the following statements as “barriers” to E-R integration efforts: Extension not valued highly as research in career tracks at the university level (*M*=3.14, *SD*=0.81); perception that in promotion and tenure reviews, research-based publication are more valued than field-based Extension publications (*M*=3.00, *SD*=1.00); lack of funding to carry out E-R integrated activities (*M*=2.94, *SD*=0.86); excessive accountability requirements limiting time available for Extension faculty to branch out from their specialties (*M*=2.82, *SD*=1.03); and lack of administrative structure to support integration activities (*M*=2.74, *SD*=1.02).

Objective 4: Strategies

Both groups “agreed” that the following strategies will help strengthen E-R integration activities at the local, college and university levels: allocating research money properly to support Extension programs (*M*=4.32, *SD*=0.64); creating positions that combine both Extension and research functions (*M*=4.23, *SD*=0.65); increasing number of graduate assistantships to work with Extension faculty (*M*=4.21, *SD*=0.73); identifying new initiatives like AFRI from USDA requiring integration of both research and Extension (*M*=4.18, *SD*=0.77); establishing a strong working relationships among research and Extension administrators (*M*=4.09, *SD*=0.75).

Conclusions

The findings of this study suggest that Extension and research faculty have varying views toward E-R integration Both groups view integration as a positive, much needed undertaking at land grant universities. Overall, both groups of faculty agreed that integration is occurring throughout the university system which is partly driven by the mandates of the external funding agencies. To this end, both groups agree that joint appointments in Extension and research are necessary to address complex issues facing society.

Both groups of faculty recognize and understand each other’s role in the college and university. They agreed that Extension is a link between the university and the public and should capitalize on each other’s role to strengthen integration activities. Findings also revealed that research was viewed as more important and valued compared to Extension and research who have limited understanding of what Extension faculty does.

Both research and Extension faculty perceived many barriers to integration efforts. Major barriers included: the lack of equal status among research and Extension and less appreciation of the work of Extension faculty compared to research faculty. Furthermore, the campus culture wherein contributions of research faculty are more valued than Extension faculty, especially in promotion and tenure reviews. Additionally lack of funding, especially for integrated activities was also viewed as a barrier.

Regarding strategies to strengthen E-R integration activities, there was consensus among both groups. Key strategies for strengthening integration activities included: increased funding in the form of seed money or the national grants such as AFRI from USDA, split appointments of faculty in research and Extension, and increased number of graduate assistants to work exclusively in integrated projects and/or programs. In addition, working together in departmental unit teams, and serving on graduate student committees were also viewed as strategies to spur E-R integration.

Implications and Recommendations

Findings of this study can be useful in determining the value of E-R integration efforts. A strong research-Extension linkage will help in broader understanding of past and future benefits of research and Extension efforts to the public good. Further, E-R integration will help develop better institutional mechanisms for connecting innovations in research and new knowledge developed to a diverse public who are the consumers of that knowledge.

It is recommended that an Extension-Research Integration Team be established. The goal of this team should be to identify, develop, implement and evaluate Extension-research integration efforts. Further, both research and Extension administration should commit resources to facilitate integration. Perhaps, a percentage of research grants secured from both private and public entities should be earmarked for integration efforts. Future research involving extension educators, other research staff, and administrators to make informed decisions about Extension-research integration activities should be undertaken and should serve as a spring board for further research.

Finally, E-R integration facilitates the integration of a deep understanding of science and technology (through research) with practical knowledge, a hands-on orientation (through Extension), and experimental skills and insights (Extension-research integration).

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The Infusion of Inquiry-based Learning into School-based Agricultural Education: A Review of Literature

Trent Wells, Fayette County High School
Jennifer Matthews, Iowa State University
Lawrence Caudle, Iowa State University
Casey Lunceford, Iowa State University
Brian Clement, Iowa State University
Ryan Anderson, Iowa State University

Introduction

In recent years, calls for increases in student achievement have paved the way for challenging teaching methods within all classrooms (Pearson et al., 2010; Stone, Alfeld, & Pearson, 2008). Such methods are desired to help address student deficiencies in critical thought, cognitive abilities, and real-world skill development (Stone et al., 2008; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006). Further, these methods should emphasize pragmatism and high-quality learning through hands-on applications that reinforce academic content, all the while grasping toward students' natural inclinations and abilities to learn useful content (Phipps, Osborne, Dyer, & Ball, 2008; Stone et al., 2008).

In order to help further enhance students' interests in various content areas, many educators have incorporated the use of inquiry-based learning (IBL) into their curricula. As supported by educational philosopher John Dewey (1910, as cited in Thoron & Myers, 2011), IBL aids in students' processes of discovery about selected topics, particularly those of interest to individual students. As a result, higher-order thinking skills (HOTS) and more cognitively-rooted ideas are more apt to occur (Thoron & Myers, 2011). Interestingly, IBL and teaching has historically occupied a very prominent role in agricultural education classrooms across the United States in the form of problem-based learning (PBL) (Parr & Edwards, 2004).

Since the work of Parr and Edwards (2004) comparing the congruency between IBL and PBL teaching styles, much advancement has been made regarding the use of IBL in school-based agricultural education (SBAE). As a result, there exists the need to further address this new knowledge and develop additional dialogue concerning the forthcoming place of IBL within agricultural education curricula. Perhaps a literature review of this area of inquiry will shed greater light on the subject.

Review of Literature

As described by Parr and Edwards (2004) and Phipps et al. (2008), PBL (i.e., IBL) is designed to expand students' cognitive capacities through exposure to ill-structured agricultural issues requiring complex thought. Numerous examples of these concepts abound in SBAE, particularly in laboratory settings, such as in agricultural mechanics facilities (Parr, Edwards, & Leising, 2008; Wells & Parr, 2011). Because many of these issues require utilizing applied academic and technical knowledge to adequately solve, higher levels of cognition are needed (Parr, Edwards, & Leising, 2009).

Agriculture teachers can select and structure classroom- and laboratory-based problems around technical issues that may exist in the real world (Parr, 2004; Parr, Edwards, & Leising, 2006). However, of vital necessity is the deep engagement of the students in the process, such as the use of questioning to draw answers and in-class research to solve a practical problem. Students become more engaged in the process of research and solving issues via inquiry-based learning. This serves as a thought-provoking example of the use of IBL in SBAE settings. However, a question remains: How can such strategies best be incorporated into additional, out-of-classroom experiences?

SAE projects allow for many teaching and learning interests to be explored, particularly in the pursuit of program development (Phipps et al., 2008; Wells & Retallick, 2013). SAE emphasizes much in developing students for and through academically-rigorous work within a practical, hands-on context (Wells & Retallick, 2013). This was particularly true for mathematics and science content integration. As SAEs are naturally rooted within classroom- and laboratory-based content areas (Ramsey & Edwards, 2012), this area exhibits much potential for academic content education and emphasis (Wells & Retallick, 2013), and are designed to be based upon student interests (Phipps et al., 2008), it stands to reason that perhaps inquiry-based instruction is paramount to the long-term durability of SAEs. Further, as SBAE seeks to incorporate academic content, such as reading, science, and mathematics curricula, alongside teaching methods that emphasize higher levels of cognition within students, the entire model of SBAE should be crafted to fit into the necessary mold of rigor and relevance (Edwards, 2004; Parr & Edwards, 2004).

Conceptual Framework

The framework of the current study was rooted in the National Research Agenda (NRA) of the American Association for Agricultural Education (AAAE) (Doerfert, 2011). In particular, this study was aligned with both Priority 4 and Priority 5 of the document. Priority 4, "Meaningful, Engaged Learning in All Environments" described how,

> "[m]eaningful learning occurs when learners go beyond rote memorization of facts to the ability to interpret the interconnectedness of facts or material, regulate their understanding, transfer the understanding of concepts to new situations, and think creatively" (Doerfert, 2011, p. 21).

Moving to Priority 5 of the NRA, "Efficient and Effective Agricultural Education Programs", this notion has underscored the need for advancing agricultural education into a model that emphasizes pragmatic, high-quality, and academically-rigorous curricula. As IBL is designed to create relevant and PBL environments (Parr & Edwards, 2004; Thoron & Myers, 2011), the sustainment of high-quality SBAE through this teaching and learning theory is well-supported.

Purpose of this Study & Objectives

The purpose of this study was to describe the historical use of IBL in SBAE. This purpose was supported by the following objective:

1) Describe the incorporation of IBL into the three-circle model of SBAE.

Methods & Procedures

To accomplish the purpose of this study, the researchers conducted a review of various studies pertinent to agricultural education, IBL theory, and student achievement. The reviewed literature was gathered from Internet resources and search engines, agricultural education magazines and textbooks, peer-reviewed journal articles, conference proceedings, and doctoral dissertations. In total, 27 (N = 27) resources were identified and used as a part of this study.

Findings

Based upon the reviewed literature, it appeared that the vast majority of the literature dealt strictly with classroom-based instruction. This finding was troubling, as researchers (Wells & Parr, 2011; Wells & Retallick, 2013) have reported that both the FFA and SAE components have exhibited much potential for alignment with academic content standards. Based upon previous literature, (Thoron & Burleson, 2014; Thoron & Myers, 2011), it would seem that these areas could, due to their embedded academic curricula, hold significant potential for the incorporation of IBL strategies. Rogers (1969, as cited in Roberts, 2006) noted that IBL can be used heavily in the experiential learning portion of SAE. As SAE emphasizes the application of classroom and laboratory content into real-world settings (Roberts, 2006), numerous potential exists for IBL in this setting. Perhaps such work is currently occurring in agricultural classrooms, particularly for Career Development Event (CDE) and SAE selection activities.

Based upon these findings, the researchers developed the following model that described the incorporation of IBL into the comprehensive SBAE program. The model depicted is based upon the three-circle model as presented by the National FFA Organization (2014). To describe this model, the literature has indicated a need for increased academic achievement and increased program relevance (Edwards, 2004; Young, Edwards, & Leising, 2009). To accomplish this purpose, academically-rooted IBL strategies have been utilized within SBAE programs; as a result, student achievement improved (Thoron & Myers, 2011). Each component is vital to the comprehensive programs and could accommodate IBL (Roberts, 2006; Rogers, 1969). Positive stakeholder perceptions and performances when utilizing academically-enhanced, inquiry-based curricula are vital to the sustainability of such an approach; both populations seemed to indicate positive reception with the use of such an approach (Conroy & Walker, 2000; Thoron & Burleson, 2014; Ulmer et al., 2013). As a result, it would stand to reason that the continued use of inquiry-based instruction would only result if such a strategy and its aligned efforts are effective.

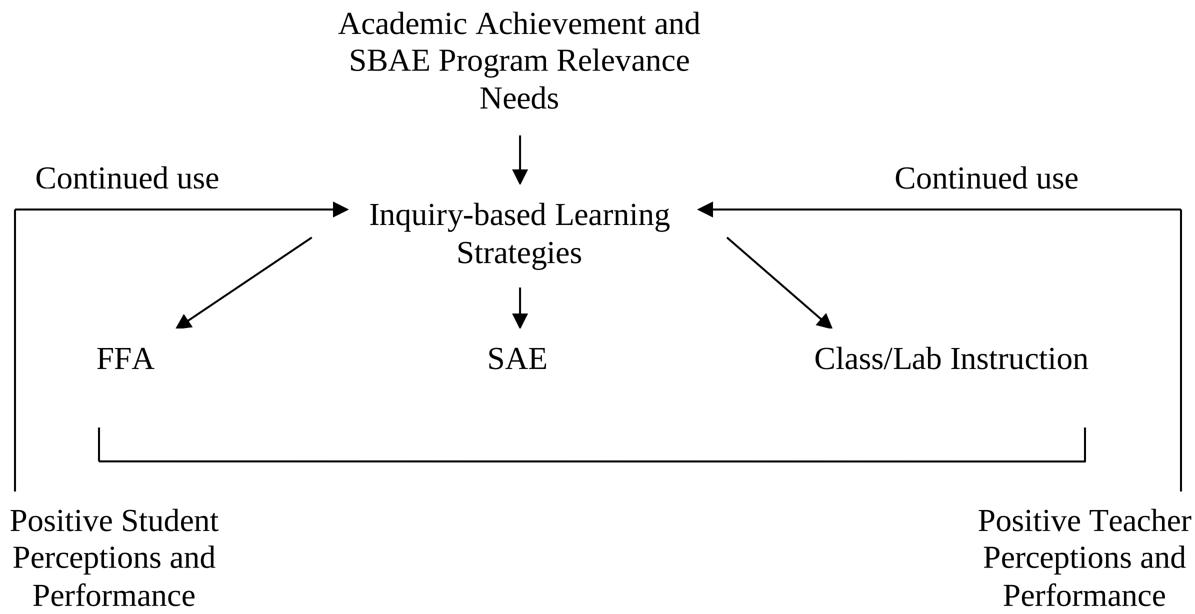

Figure 1. IBL in the comprehensive SBAE program.

Conclusions

As teacher accountability in school settings is increasingly important and emphasized with the passage of new legislation, it is vital that students are meeting increased achievement standards (Edwards, 2004). The research body presented here has illustrated that inquiry-based instruction in SBAE classrooms not only encourages the curiosity of students, but also helps them to develop the higher-order critical thinking skills that students need to master the new skills and problems that they will face (Phipps et al., 2008) Such rigorous instruction should be prevalent and demanded across all areas of career and technical education (CTE) (Stone et al., 2008).

Regarding the AAAE's National Research Agenda, this study provided an interesting look into how agriculture teachers are working to address Priority 4 and Priority 5 (Doerfert, 2011). Further, as IBL emphasizes higher-order thinking (Phipps et al., 2008; Thoron & Myers, 2011), more engaged learning can occur within agricultural coursework. This engagement could occur through increasing the rigor as well as relevance of SBAE, a need well-documented (Edwards, 2004). The use of this instructional strategy also addressed Priority 5's description of the need for more "Efficient and Effective Agricultural Education Programs" (Doerfert, 2011). Based upon previous research (Thoron & Burleson, Thoron & Myers, 2011; Ulmer et al., 2013), IBL has helped to positively influence student achievement and perceptions of the utility of the modern SBAE program. As a result, the use of this valuable teaching method appears to pay dividends toward the sustainability of SBAE.

Discussion, Implications, & Recommendations

Recently, the National Council for Agricultural Education developed the Curriculum for Agricultural Science Education (CASE) (CASE, 2013). The objective of this program was to provide agriculture teachers with a method of enhancing the rigor and relevance of SBAE content. In regard to CASE, Ulmer et al. (2013) illustrated that many CASE Institute attendees were present due to administrator requests. Perhaps this is indicative of administrators' perceptions of the value of agricultural education as a context for improving student achievement (Ulmer et al., 2013). As Paulsen and Martin (2013) indicated, administrator perceptions can hold ramifications for SBAE programs, particularly in terms of the value and activities of programs. Because student achievement increases are paramount for agricultural education (Edwards, 2004), closely involving school administrators in planning agricultural curricula and activities may create greater regards for the work of the agriculture teacher. Important decisions (i.e., funding) often remain in the hands of administrators; thus, administrators must understand the work of a high-quality SBAE program and its teacher(s) (Paulsen & Martin, 2013).

As demonstrated by Thoron and Myers (2011), IBL holds much promise for increasing students' content knowledge while increasing their academic achievement. Such work can highlight the potential value of SBAE for overall student development. Additional research should follow suit and work to establish a more solid body of knowledge regarding IBL in SBAE. New literature should also emphasize methods that specialized teaching strategies can utilize to increase students' retention of content knowledge, as described by Doerfert (2011). Such methods could hold much promise for furthering the value of SBAE in modern school settings (Parr et al., 2006).

Regarding classroom practice, agriculture teachers should continuously look for methods to integrate IBL into their coursework (Parr & Edwards, 2004; Washburn & Myers, 2010). As this practice is more commonly known as PBL within SBAE (Parr & Edwards, 2004), many teachers utilize this method (Phipps et al., 2008). Interestingly, as science curricula are often taught through IBL, and as science is inherently tied within agriculture, many teachers report that pressure to practice science integration has come from a top-down approach (e.g., administrator requests, etc.) (Washburn & Myers, 2010). Perhaps teachers feel more inclined to teach through IBL only when science integration pressures are a factor. In-service meetings may serve as a valuable medium for opening the dialogue concerning these issues.

As developing and instilling the practice of effective teaching is achieved at the pre-service level (Phipps et al., 2008), teacher education coursework should include instruction in IBL (Washburn & Myers, 2010). Such coursework should emphasize the use of IBL in all facets of SBAE. Thoron and Myers (2011) described how this method of teaching can positively influence students' classroom performance, while Wells and Retallick (2013) found that significant potential for academic instruction exists within the realm of SAE. As SAE serves as the natural outlet of classroom/laboratory-based teaching (Ramsey & Edwards, 2012), IBL may hold significant possibilities for increasing student understanding of real-world phenomena that may result in higher overall program experience quality. Wells, Perry, Anderson, Shultz, and Paulsen (2013) found that experiences at the secondary level can influence post-secondary educational pursuits. Thus, agriculture teachers should heed these calls to improve professional practice, as the eventual fate of the agricultural education discipline may depend upon it.

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Perceptions of the Participants of the NATAA Ambassadors Workshops toward Integrating Science into School-Based Agricultural Education Curriculum

Jessica M. Blythe, West Virginia University
Brian E. Myers, University of Florida

Introduction

Science has been a part of agricultural education since the passage of the Hatch Act in 1887 (True, 1929; Vaughn, 1993), and in 1988 the National Research Council recognized the need to define methods necessary to guide secondary agricultural teachers as they increased the amount of science highlighted in the agricultural curriculum (Thompson & Balschweid, 2000). Past researchers have found that agricultural teachers are willing to integrate science into their curriculum and have established that teachers have positive thoughts related to utilizing a more science-based curriculum (Balschwield & Thompson, 2002; Dyer & Osborne, 1999; Myers & Thompson, 2009). Professional development (PD) programs have historically assisted agriculture teachers in developing the knowledge and skills necessary to perform their teaching roles (Barrick, Ladewig, & Hedges, 1983; Birkenholz & Harbstreit, 1987), including assisting with increasing science integration in secondary agriculture classrooms.

One of the longest running national PD opportunities for secondary agriculture teachers has been the National Agriscience Teacher Ambassador Academy (NATAA). NATAA focuses on the integration of science and the incorporation of inquiry-based instruction (IBI) into secondary agriculture classrooms to help develop students' scientific knowledge (NAAE.org, 2013). NATAA has utilized a train-the-trainer (TtT) PD model, which intensively trains agriculture teachers to become ambassadors and in turn train additional secondary agriculture teachers through workshops. Though research has shown that NATAA creates change in the ambassadors' teaching practices (Myers, Thoron, & Thompson, 2009; Shoulders & Myers, 2011; Thoron, Myers, & Abram 2011), the impact of ambassador-led workshops on the participants' teaching practices had not been determined, thus the reason for the research.

Conceptual Framework

Professional development has been considered one of the most effective methods of changing teacher practice (Darling- Hammond & Bransford, 2005; Supovitz & Turner, 2000). A constructivist perspective provides the basis for examining teacher PD within this research. Based on the general principles of learning derived from constructivist theory, Fosnot and Perry (2005) suggested several instructional practices, such as opportunities for exploration of and reflection on new knowledge and active engagement, which have been supported by additional PD literature and may be helpful in planning effective PD.

The conceptual model guiding this research represents the interactions taking place specifically during a TtT PD program (see Figure 1). The TtT form of PD includes two generations of PD programing and participants, which occur in two distinctly different contexts. The contexts account for the environment in which the PD occurs. Within the context there is interaction between the leaders of the PD, the PD programming, and the teachers' learning from the PD within each context.

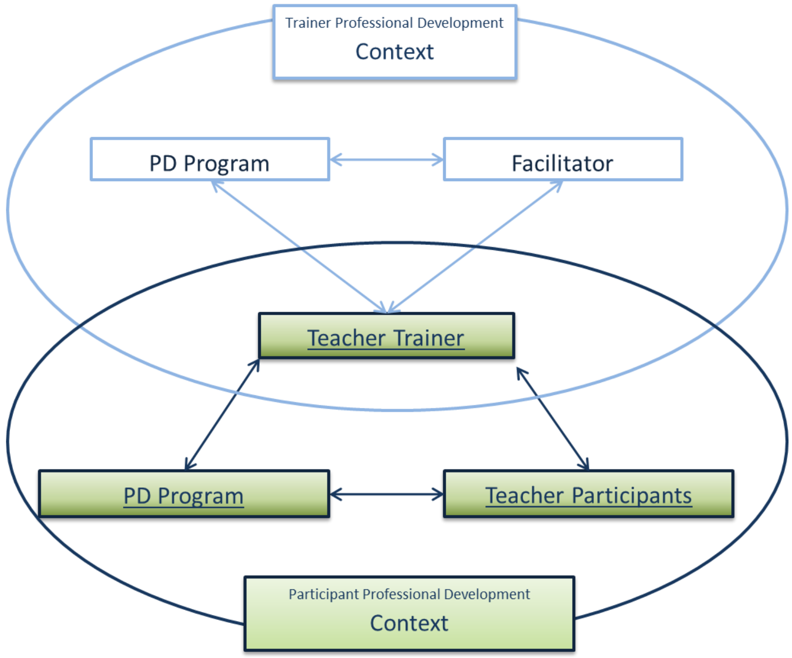

Figure 1. Train-the-trainer form for teacher professional development. (Adopted from Borko, 2004).

Purpose and Objectives

The purpose of this study was to describe the influence of the TtT PD model on NATAA workshop participants' perceptions of science integration in agriculture. The study had one objective: to describe the NATAA workshop participants' immediate and long-term perceptions of science integration in agriculture following a NATAA ambassador-led PD workshop.

Methods

This study utilized a quasi-experimental, post-test only design. The population of this study consisted of teachers who attended NATAA workshops presented by NATAA trainers at the 2012 National FFA convention and/or the 2012 NAAE Convention. The entire population was accessible, therefore making this a census of the population.

The Integrative Science Survey (ISS) instrument developed by Thompson and Schumacher (1998) was used to assess teacher perceptions related to preparation for, barriers to, and support for integrating science into agriculture programs at four data-collection points (January, May, September, December) throughout the year following participants' workshop participation. The reliability coefficients for the ISS ranged from .89 to .96 over the four data-collection points. The response rate varied from 16.89% to 30.81% (Jan. = 30.81%; May = 29.06%; Sept. = 16.89%; Dec. = 25.67%). Non-response does not greatly impact the study, because this study is a census and is not generalizable to the general population (Fowler, 2014).

A majority of respondents in this study were female (60.5%), and the mean age of respondents was 40. The average number of years of teaching experience for the respondents was 14.64 (SD = 8.97). Many of the respondents have previously attended an NATAA workshop

(50.9%) and a majority had attended other workshops focused on science integration in agriculture (55.3%). Respondents had a variety of post-secondary education levels, ranging from a bachelor's degree to a doctoral degree.

Findings

The results indicated the respondents had favorable perceptions of science integration overall and most respondents indicated they planned to increase the levels of science integration in their agricultural programs. Nearly all respondents indicated they had integrated science into their agricultural education programs, though the percentage of respondents who indicated they were content with the level to which they currently integrate science varied between data-collection points.

At all data-collection points, more than 90% of respondents agreed that science concepts are easier for students to understand when science is integrated into an agricultural education program and that students are better prepared in science after they have completed a course in agricultural education that integrates science. Additionally, in September and December, more than 93% of respondents indicated that students are better able to make connections between scientific principles and agriculture when science is integrated into agricultural education programs. At all four data-collection points at least 40% of respondents disagreed with the statements that 'less effort is required to integrate science in advance courses as compared to introductory courses' and 'it is more appropriate to integrate science in advanced courses than into introductory courses'.

At all data-collection points, fewer respondents reported feeling prepared to teach integrated physical science concepts than integrated biological science concepts. More than 88% of respondents at all data collection points indicated teacher-preparation programs in agricultural education should provide instruction on science integration.

At all data-collection points, more than 70% of respondents reported a perceived increase in total program enrollment after integrating science into the agricultural curriculum. In May, September, and December, a majority of responses indicated a perceived increase in high achieving students' enrollment in agriculture programs that integrated science content. A perceived decrease in enrollment in agricultural programs when integrating science related to low achieving students was most commonly reported at all four data collection points.

A majority of respondents from all data-collection points disagreed with the notion that science integration is not necessary and there is a lack of administrative support for science integration. The most agreed-with statements were related to concerns about insufficient time and support to plan implementation, lack of funding and necessary materials, as well as concerns about large class sizes.

Conclusions and Implications

Respondents of this study have favorable attitudes towards integrating science into their programs. Respondents indicate that integrating science into agriculture courses makes science concepts easier to understand for students and better prepares students in science. Additionally, respondents report that science integration is appropriate at all levels of an agriculture program. These are supported by the grand means (3.74, 3.79, 3.66, 3.82), which are interpreted on a five point Likert scale. This conclusion implies that integrating science into agriculture programs will produce more science-literate students who are better prepared to compete in today's society, which aligns with previous literature (Thompson & Balschweid, 1999; Layfield, Minor, & Waldvogel , 2001, Myers & Washburn, 2008; Myers, Thoron, & Thompson, 2009). Additional findings from this study found that respondents felt students would be better prepared in science after completing a course in agriculture that integrated science. Additionally respondents felt that those students may learn more about agriculture when science is an integral part of their instruction. Science integration in agriculture may also help students make connections between science and agriculture concepts.

Respondents in this study are more comfortable teaching biological science concepts than physical science concepts in agricultural programs. This conclusion indicates that teachers may have higher levels of self-efficacy in biological sciences and may have been better prepared to teach biological science then physical sciences. This conclusion aligns with previous literature, which found that teachers emphasized a greater understanding of biological sciences than physical sciences (Thompson & Balschweid, 1999).

However, all respondents did not agree it was essential to require additional science coursework in preservice preparation programs. They did indicate it was important for preservice teachers to be provided with instruction on how to integrate the science principles and concepts into agriculture courses. This may imply that the teachers think that the preservice teachers have the content knowledge, but need to know how to utilize it in the classroom setting.

Agriculture teachers recognize the need to have preservice teachers gain experiences in agriculture programs that integrate science, during early field experiences and student teaching internships. This indicates that respondents see the need for preservice agriculture teacher-preparation programs to provide preservice teachers with examples of agricultural teaching in secondary agriculture programs that strongly integrate science. It is essential teacher-preparation programs identify agriculture programs that integrate science and utilize these programs when placing preservice teachers for early field experiences and student teaching internships.

Respondents in the study indicate that when science integration in agriculture occurs, there is an increase in total program enrollment as well as in enrollment of high achieving students, though some respondents indicate an enrollment decrease of low-achieving students. This implies that teachers who have already started to integrate science may have experienced an increase in total program enrollment because of science integration, as well as an increase in enrollment from high achieving students. However, integration of science may change low achieving students' perceptions about agriculture programs that integrate science, causing a decrease in enrollment of low achieving students.

Respondents feel science integration into agriculture programs is positive, and indicated the biggest challenges to integrating science into programs are the amount of planning time and support needed while integrating science as well as a lack of funding. These findings are similar to previous findings that indicated insufficient time and planning support were the biggest barriers to integrating science into agricultural education curriculum (Balschweid & Thompson, 2002; Warnick & Thompson, 2007; Myers, Thoron, & Thompson, 2009). This implies that there is a need for increased planning time for teachers as they implement science integration and that systems must be developed to support teachers as they create changes in their classroom practices. Additionally, avenues of financial support that can provide agricultural teachers with the classroom supplies and PD to implement science integration in agriculture must be developed.

Recommendations

This study provides evidence supporting science integration in secondary agriculture classrooms. The following are recommendations for research related to science integration in agriculture:

- Increased evaluation is needed to assess the effectiveness of the NATAA PD series, especially focused on the second generation of workshops and on developing agriculture teachers' knowledge and abilities related to science integration.
- Further studies should move beyond gathering teacher perceptions of total program enrollment based on science integration and should focus on the impact had by science integration on the number and ability level of students enrolling in agriculture programs over time.
- More experimental studies that examine science integration are needed. Teacher self-efficacy, motivation, and perceptions of agriscience should be grouping variables examined in future studies to provide for their role in how science is utilized in secondary agricultural programs.

Teachers integrating agriculture and science can be assisted through recommendations for preservice education and PD programs.

- To assist teachers in effectively accentuating the science naturally found in agricultural concepts, additional PD opportunities should be developed at the state and national level to increase the number of agricultural teachers who develop positive methods of science integration.
- Teacher education programs should develop coursework that demonstrates the use of agricultural contexts to integrate science. This instruction should include developing content knowledge in biological and physical sciences as well as the pedagogical knowledge needed to integrate these concepts and principles into an agricultural context.
- Teacher education programs should develop resources to focus on an integrated track for preservice teacher preparation as well as continue to provide inservice PD for science integration.

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Assessing the Impact of Participation in a National Agriscience Pre-service Teacher Program on Perceptions of Science Integration and Preparation in Agricultural Education

Amy Smith, University of Minnesota
Scott Smalley, South Dakota State University

Introduction

The integration of science concepts into school-based agricultural education programs is nothing new. In fact, Hammonds (1950) recognized the 'organized body of knowledge' we call the science of agriculture is deeply rooted in the sciences that contribute to agriculture" (p.5), ultimately suggesting that agriculture *is* science and the two cannot be separated. Nonetheless, in 1988, the National Research Council suggested "ongoing efforts…to upgrade the scientific and technical content of vocational agriculture courses" (p. 35). Soon after this, many agricultural education programs began rebranding and sought to draw attention to science concepts inherent in agricultural education. In 1993, Dormody reported one in three agriculture teachers were offering science credit for agriculture courses; that number has likely increased steadily since.

Opportunities rooted in science have also expanded for agriculture teachers. Initiatives such as Curriculum for Agricultural Science Education (CASE), National Agriscience Teacher Ambassador Academy (NATAA), and Agriscience Integration Institute (NAII) provide intensive training for agriculture teachers. These programs provide training and resources "to enhance the rigor and relevance of agriculture, food, and natural resources for students" (CASE, 2013), "improve science learning and performance" (NAAE, 2014), and utilize inquiry-based learning. While such efforts are valuable for teachers, few are designed for pre-service participants. Similarly, many researchers have studied science integration in agriculture (Balschweid, 2002; Balschweid & Thompson, 2002; Dormody, 1993; Grady, Dolan & Glasson, 2010; Myers & Washburn, 2008; Washburn & Myers, 2010), though fewer have focused on how to better prepare pre-service teachers for science integration.

Framework

This study is framed conceptually by a model for teacher preparation in agricultural education (Whittington, 2005) shown in Figure 1. The model was built upon four primary objectives of teacher education reform: (a) foundations and major goals; (b) knowledge, skills, and dispositions; (c) state and national teacher licensure standards; and (d) the scope, structure, and sequencing of educative experiences. These four objectives were used to identify stages of pre-service teacher development.

Specifically, this research connects to the "professional practice" component of teacher preparation displayed in the model. Typically a focus during the junior and senior years of an agricultural education program, opportunities for professional practice must be provided to help develop requisite agriculture teacher knowledge, skills, and disposition. As beginning agriculture teachers are expected to demonstrate knowledge and skills in science and inquiry based instruction, professional practice in this area is especially important.

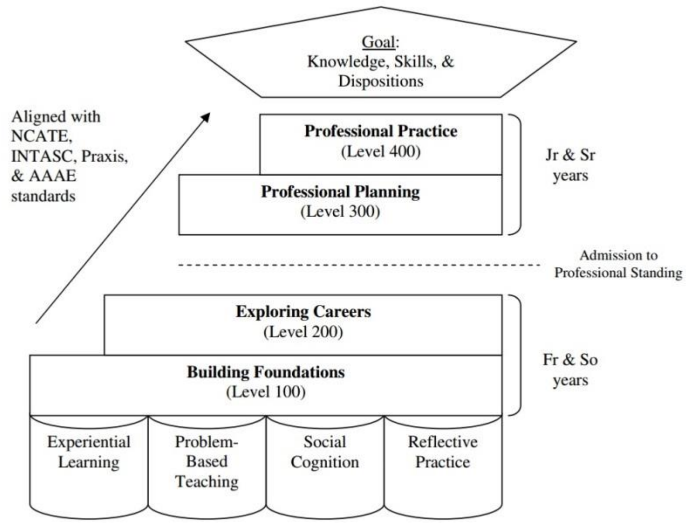

Figure 1. A model for teacher preparation in agricultural education. (Whittington, 2005).

Purpose & Objectives

The purpose of this study was to explore the impact of a professional development program on pre-service teachers' perceptions of science integration, preparation and inquiry-based instruction in agricultural education using a pre and post survey. Three objectives guided this research: 1) describe the characteristics of participants in the National Agriscience Preservice Teacher Program, 2) identify participants' perceptions toward the integration of science into agriculture prior to and following participation, and 3) identify participants' self-perceived level of preparation to integrate science into teaching prior to and following participation.

Methodology

The National Agriscience Preservice Teacher Program consisted of a 4-hour workshop offered for pre-service agricultural education students during the 2013 National FFA Convention. Program participants were undergraduate or graduate students who had applied to participate and were within the final year of a teacher preparation program. National Association for Agricultural Educators (NAAE) staff provided the frame for the 16 participants. An existing instrument (Myers & Washburn, 2008) was used with permission. The instrument had been deemed valid and reliable; a panel of experts had reviewed the instrument for face and content validity, and a Cronbach alpha coefficient of 0.80 was reported for reliability (Myers & Washburn, 2008). The instrument was administered using Qualtrics and measured participant responses using a five-point Likert scale, ranging from strongly disagree to strongly agree. Because of the small and accessible population, a census was conducted for both the pre and post survey. The pre-survey was administered approximately three days prior to the start of the workshop, with the post survey distributed seven days after the workshop concluded. For pre and post survey, each participant received an invitation, followed by an email containing a link to the instrument. Two reminders were sent to non-respondents, resulting in a 100% response rate on the pre survey (n=16). One participant did not complete the entire professional development program, and therefore was removed from the post survey group (n=15).

Results/Findings

Due to the nature of the research methodology utilized, the results of this study should not be generalized beyond this small group of pre-service agriculture teachers who self-selected to participate in this program to all pre-service teachers. Rather, the results should be interpreted with caution, only describing this population's perceptions of science integration, preparation and inquiry-based instruction.

Of the sixteen participants in the program, ten (62.5%) participants were female and six (37.5%) male. Participant age ranged from 21 to 24 years of age, all of whom were pursuing teacher licensure and in their final year of college. Thirteen were pursuing a Bachelor of Science degree, while three were pursuing a Masters degree. One participant was currently student teaching; fifteen would complete student teaching in Spring 2014. Prior to completion of the professional development program, pre-service teachers' *perceptions towards the integration of science* focused on an understanding of science concepts (Table 1). Participants asserted that integration of science concepts would enhance student learning, yet were less certain about the ideal academic level for integration and effort required.

Table 1
Pre-service Student Perception Toward Integration of Science

	Pretest		Posttest	
Statement	Mean	SD	Mean	SD
Science concepts are easier for students to understand when science is integrated into the agricultural education program.	4.56	0.63	4.53	0.52
Students are better prepared in science after they completed a course in agricultural education that integrates science.	4.44	0.63	4.60	0.51
Students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of their instruction in agricultural education.	4.25	0.45	4.67	0.49
Integrating science into agriculture classes increases the ability to teach students to solve problems.	4.13	0.81	4.40	0.51
Students learn more about agriculture when science concepts are an integral part of their instruction.	4.06	0.57	4.53	0.52
Agriculture concepts are easier for students to understand when science is integrated into the agricultural education program.	3.75	0.77	4.13	0.64
Integrating science into the agricultural education curriculum more effectively meets the needs of special population students (i.e. learning disabled).	3.63	0.81	3.73	0.88
Students are more motivated to learn when science is integrated into the agricultural education program.	3.56	0.81	4.20	0.86
Integrating science into the agricultural education program requires more preparation time than teaching a more traditional agriculture curriculum.	3.56	1.09	3.87	0.99
It is more appropriate to integrate science in advanced courses than into introductory courses.	2.50	0.73	2.13	0.64

Less effort is required to integrate science in advanced courses as compared to introductory courses.	2.44	1.09	2.40	0.99

Note. 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

Following the professional development workshop, pre-service teachers most agreed with the statement, "students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of their instruction in agricultural education" (M= 4.67, SD= 0.49). The two statements participants identified the least with were "it is more appropriate to integrate science in advanced courses than into introductory courses" and "less effort is required to integrate science in advanced courses as compared with introductory courses."

Pre-service teachers' perceptions regarding their *preparation to integrate science* are provided in Table 2.

Table 2

Pre-service Student Perception Regarding Preparation to Integrate Science

	Pretest		Posttest	
Statement	Mean	SD	Mean	SD
Teacher preparation programs in agriculture should provide instruction for undergraduates on how to integrate science concepts/principles in agriculture.	4.56	0.63	4.60	0.51
When placing student teachers, teacher preparation programs should expect cooperating teachers to model science integration.	3.75	0.86	4.13	0.52
Teacher preparation programs should require that students conduct their early field experience program prior to student teaching with a teacher who integrates science into the agricultural education program.	3.31	0.60	4.27	0.70
I feel prepared to teach integrated biological science concepts.	3.31	0.95	3.73	0.88
Teacher preparation programs in agriculture should require students to take more science courses (biology, chemistry, physics, etc.).	3.25	1.00	3.53	0.83
I feel prepared to teach integrated physical science concepts.	3.19	1.17	3.60	0.83

Note. 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

The statement most strongly agreed with by pre-service teachers stated that teacher preparation program should provide instruction on science integration. With regard to perceptions of their own preparation, there was a lower level of agreement. However, following the workshop, the mean score for *preparation to integrate science* did increase from 3.19 to 3.60.

Table 3 outlines the pre-service teachers' perceptions statements on collaboration related to science integration.

Table 3
Pre-service Student Perception Regarding Collaboration

Statement	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Collaboration with local businesses would benefit agriculture students.	4.81	0.40	4.60	0.51
An agriculture department has something to offer a science department.	4.56	0.51	4.47	0.52
Collaboration with a science department would benefit agriculture students.	4.63	0.62	4.47	0.52
Collaboration with university faculty would benefit agriculture students.	4.56	0.63	4.47	0.52
A science department has something to offer an agriculture department.	4.56	0.51	4.40	0.51
An agriculture department and a science department should work together in a collaborative effort to benefit students.	4.50	0.63	4.27	0.59
An agriculture department and a science department share similar philosophies about teaching and learning.	3.38	0.96	3.93	0.46
An agriculture department and a science department have a cooperative relationship.	3.44	1.15	3.73	0.96
I would not be as successful integrating science without the help of a science teacher.	3.81	1.22	3.67	1.05
An agriculture department and a science department share similar viewpoints toward the environment and agriculture.	3.19	0.91	3.47	0.83
I feel a science program will not want to work an agriculture program.	3.06	0.93	2.80	0.94
I feel an agriculture program will not want to work with a science program.	2.38	0.96	2.20	0.94

Note. 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

The most agreed upon statement regarding *collaboration* on the pre survey was the item which stated "collaboration with local businesses would benefit agriculture students" (*M*= 4.81, *SD*= 0.40). On the post survey, the same statement yielded a mean score of 4.60 (*SD*= 0.51). The perception statement pre-service teachers least agreed with on both the pre and post survey was "I feel an agriculture program will not want to work with a science program."

Conclusions/Implications/Recommendations

Overall, pre-service agriculture teacher participants in the National Agriscience Pre-service Teacher Program (NAPTP) identified value in the integration of science into agricultural instruction. This echoed Myers and Washburn's research with practicing agriculture teachers (2008) which suggested agriculture teachers believe integrating science in the curriculum allows students to see the connection between scientific principles and agriculture.

Responses regarding science integration indicated a perceived positive impact on student learning and achievement. Similarly, Myers and Washburn (2008) found teachers believed that the integration of science in the classroom had positive implications, including increases enrollment and enhances stakeholders' view of a program. NAPTP participants seemed to recognize that science integration may require more effort from the teacher, and did not believe that it was more appropriate or easier to integrate science content into advanced courses.

Participants agreed collaboration would benefit the agricultural program when working with local businesses, university faculty and the local science department. Responses also indicated support for cooperating teachers modeling the integration of science; this was consistent with Myers and Washburn's (2010) findings, which suggested that cooperating teachers should model how to integrate science.

Implications for practice and further research emerge from this study. Certainly, NAPTP program coordinators should review the results of this study and other feedback provided by participants to explore ways to improve or enhance the professional development experience for pre-service teachers. Additionally, teacher educators should explore ways to strengthen pre-service teacher preparation in the area of science integration and inquiry-based learning. If increased rigor through science integration is expected of school-based agriculture teachers, beginning teachers must be able to meet this expectation upon graduation. Further, if cooperating teachers should model science teaching behaviors, teacher educators must further explore whether or not cooperating teachers have been fully prepared to do so.

Additional research should be conducted in the form of a longitudinal study to explore NAPTP participants' integration of science concepts during student teaching/upon graduation and into the profession as a secondary agricultural educator. Additionally, it would be valuable to study the perceptions of science integration and preparation of beginning, mid-career and experienced agricultural education teachers across the country.

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Impact of Knowledge of Content and Students on Beginning Agriculture Teachers Approaches to Teaching

Amber H. Rice, University of Missouri
Tracy Kitchel, University of Missouri

Introduction and Literature Review

Teacher and teaching quality can greatly impact student achievement (Kaplan & Owings, 2002). Mathematics teachers' content knowledge positively predicted student achievement (Hill, Rowan, & Ball, 2005). However, content knowledge alone, while recognized as an important knowledge base, is not enough (Baumert et al., 2010). Transforming content knowledge for student understanding requires teachers to use their pedagogical content knowledge (PCK) (Halim & Meerah, 2002), making PCK the greatest single contributor to explaining student progress (Baumert et al., 2010).

PCK is the combination of teachers' content knowledge and pedagogical knowledge to create a knowledge base specific for teaching (Shulman, 1986). One important component of PCK is knowledge of content and students (KCS) (Hill, Ball, & Schilling, 2008). Teachers' KCS is a combination of knowledge about how students think and learn content combined with content knowledge and includes knowing: common student errors, student understanding of content, student developmental sequences, and common student computational strategies (Hill et al., 2008). According to Chick, Baker, Pham, and Cheng (2006), teacher behaviors when using KCS included predicting what concepts would be most difficult for students and identifying where students were developmentally with content. In a study of novice mathematics teachers, KCS was a pivotal point for PCK development (Lannin et al., 2013).

Research has been conducted within various disciplines and numerous frameworks created for PCK (Chick et al., 2006; Gess-Newsome & Carlson, 2014; Hill et al., 2008; Hashweh, 2005; Lee, 2011; Loughran, Berry, & Mulhall, 2012; Magnusson, Krajcik, & Borko, 1999). Recently, PCK was defined as knowledge of, rationale behind, planning for, and act of teaching a specific piece of subject matter, in a specific context, to support student learning (Gess-Newsome & Carlson, 2014). This definition focuses on the topic specific nature of PCK (Darling-Hammond & Bransford, 2005; Etkina, 2010; Van Driel & Berry, 2012), necessitating research for agricultural education, which may be unique to other disciplines due to breadth and depth of content covered (Barrick & Garton, 2010).

In a case study, a mathematics student teacher was unable to explain mathematical concepts to students that were relevant and developmentally appropriate, despite having an extensive content background (Borko et al., 1992). In science education, studies found preservice teachers struggled to transform subject matter to promote student understanding (Diakidoy & Iordanou, 2003; Halim & Meerah, 2002; Van Driel, DeJong, & Verloop, 2002). Experience in the field is one of the most effective ways to develop PCK (Hashweh, 2005; Nilsson, 2008); however, without a guiding framework, teachers may not be developing these skills.

Teachers' knowledge of student thinking about content is an important piece of transforming content for student understanding (Kennedy, 1998), emphasizing a need to focus on KCS in research and practice. Using the contextual framework of PCK, teachers' skills can be examined and understood (Abell, Park Rogers, Hanuscin, Lee, & Gagnon, 2009). Focusing on beginning agriculture teachers who are still in crucial stages of developing PCK and describing their process of breaking down content knowledge for teaching could be an important starting point for agricultural education research.

Central Question

The central research question was: How does agriculture teachers' KCS influence their process of breaking down content knowledge for teaching? This research question aligns with the 2011-2015 National Research agenda for agricultural education, meaningful and engaged learning in all environments (Doerfert, 2011).

Methods

Data analyzed were part of a larger study examining the process beginning agriculture teachers engage in when deconstructing their content knowledge for student understanding. Grounded theory methodology, guided by Corbin and Strauss (2008), was utilized for data collection and analysis because it is an appropriate method for investigating a process (Corbin & Strauss, 2008). Five to eight years teaching experience is when expertise begins to be achieved (Darling-Hammond & Bransford, 2005). Therefore, Missouri agriculture teachers with two to four years of classroom experience were recruited to focus on beginning teachers. All participants were purposefully graduates of the University of Missouri to garner similar teacher preparation experiences. Thirteen teachers fit these requirements and were within 180 miles of the University of Missouri for fieldwork. Out of 13 teachers, five agreed to participate, two males and three females. One teacher was in a single teacher department; the rest were in multi-teacher departments. Four teachers were employed in rural school districts; one teacher was employed in a suburban school district. Due to variation in content taught in agriculture, we focused on lessons integrating science concepts.

First, data were collected using video recorded classroom observations lasting 45 minutes. Second, field notes were taken during observations to create a comprehensive picture of the deconstructing phenomenon because people are often unaware of their actions or unable to recall what happened (Corbin & Strauss, 2008). Third, one-on-one semi-structured interviews were conducted after observations. Questions evolved throughout the process to meet the needs of concepts being investigated (Corbin & Strauss, 2008). As data collection and analysis continued, teachers were contacted via e-mail for clarification and confirmation of information.
Field notes, video transcriptions, and interview transcriptions were analyzed to achieve triangulation of data (Creswell, 2013). Analysis included open, axial, and selective coding (Corbin & Strauss, 2008) and NVivo 10 software was utilized. During collection, a constant comparative method was used to compare data against data (Corbin & Strauss, 2008). Interview questions were adapted to follow emergent categories. Memos were used as a tool for meaning making (Denzin & Lincoln, 2000) and to ensure credibility through reflexivity (Creswell, 2013). Relevant literature provided sensitizing concepts for this study (Corbin & Strauss, 2008).

Findings

Student Enrollment in Multiple Courses Influenced Type and Depth of Content Covered

All teachers referenced making an effort to consider students' prior knowledge in agriculture and core content when planning and teaching. Often agriculture teachers have to balance curriculum across multiple courses and attempt to avoid unnecessarily repeating or leaving out content. Jordan discussed this balance, "You just look for ways to maybe incorporate [content] in other classes or try to switch up your class and that's where you can cover information you want to cover." In some schools there was an effort to teach complementary curriculum across subject areas to increase transfer and in multi-teacher departments there was pressure to be consistent between agriculture courses. As the novice teacher in her department, Melissa often felt like she had to adapt her content.

Student Engagement Methods in the Classroom were not Primarily Driven by Content

A common method to engage students in the classroom was to have them participate in activities. Lecture does not work best as a delivery method for understanding and retention (Halpern & Hackel, 2003). Engagement of students was a struggle for many teachers. Jeff discussed his engagement strategies, "I throw the video in there. That's the number one problem I run into though is engagement and keeping kids focused on the topic." While student engagement is important for learning, the role of content was often absent in teachers' decisions. Instead, the primary focus was keeping students entertained instead of how to best represent content for student understanding.

Differing Perceptions of Content "Difficulty" for Students Shaped Teaching Decisions

Difficulty or perceived difficulty of content for students also emerged as a theme. Tiffany described her experience with teaching a farm management course. "When I taught it the first time, elasticity of demand blew a few kids' minds. It was to the point where we took a test and they just didn't even try it." Students' negative experiences with other courses also played a role. Sometimes teachers were not sure if students were developmentally ready for content. Mary expressed her concern for not knowing what to withhold from students. "Because sometimes I read through stuff and I am like, do they know this? Should they not know this?"

Often teachers experienced frustration with teaching content students struggled with but they perceived as lower level knowledge, such as identification. Since identification is a component of many career development events (CDEs) within FFA (National FFA, 2012), it was also an important part of agriculture classroom curriculum and foundation for knowledge. Melissa described identification as a barrier to student learning. "Weed and grass identification, that was really hard, just the ID-ing part, getting them to differentiate between plants."

Deconstructing Content for Students Step-by-Step was Deemed Important

Teachers discussed deconstructing content step-by-step as a strategy for teaching content. The concept of 'forcing' students to learn particular content was one technique Tiffany utilized involving a step-by-step process. "So I would sit down with them during class and go through it step-by-step with them until they got it and just force them to think about it." Often teachers noted lacking content knowledge; however, some teachers had specialty areas of content. When describing a meat science lesson, a high knowledge area, Jeff indicated difficultly explaining concepts. "Like on quality grading- Mr. W how do you know that's prime? Well because it's prime- you know? …The hardest thing is for me to translate things that you instinctively know into ways for them to understand." Jeff's frustration is consistent with literature stating expertise can be a barrier to teaching because experts don't always realize steps they are taking to solve a problem (Bransford, Brown, & Cocking, 2000).

Discussion

All teachers recognized the importance of students' prior knowledge in learning content, consistent with literature (Bransford et al., 2000). However, there were instances where they did not know how to use that awareness to facilitate further learning. It is recommended teachers are provided more opportunities to explore integrating students' prior knowledge into the curriculum. Overlap in agriculture content from core content areas necessitates working with those teachers to align and compliment curriculum. With an emphasis on high stakes testing (NCLB, 2002), this could be a way to substantiate agricultural education's role in student learning.

While the importance of student engagement pervades educational literature (Trowler, 2010), teacher emphasis was predominately centered on student entertainment and less about techniques for particular content. Varied instructional strategies align with the principle of teaching and learning, variability (Rosenshine & Furst, 1973). However, has this principle, albeit important, been simplified by preparation programs or teachers to focus primarily on interchanging strategies and less on which strategies are best for content? Recommendations include incorporating student thinking about agriculture content more explicitly in teacher preparation.

Difficulty of tasks also influenced teachers' approaches to content. Vygotsky's (1978) concept of zone of proximal development described the amount of learning students can accomplish with and without assistance. Knowledge of developmentally appropriate content for students and student learning capacity was a concern for teachers, and a fundamental component of KCS (Hill et al., 2008). In a self-efficacy study, Wolf (2011) reported moderate to low levels of agriculture teacher capability for adjusting lessons for individual students. Additionally, 36% of agriculture teachers expressed doubts about students' capacity to handle integrated science material in agriculture courses (Thoron & Myers, 2009). Investigating student as learner's courses during teacher preparation could be important future research.

Teachers expressed frustration with students' difficulty with 'easy' content, specifically identification. In the revised version of Bloom's taxonomy (Anderson & Krathwohl, 2001), identification falls under the lowest level in the hierarchy- remember. The perceived importance of identification may stem from its role as a foundational knowledge base or its prevalence in CDEs (National FFA, 2012). Perhaps frustration with students' not grasping identification connects to students' prior knowledge and teacher difficulty in using that knowledge to build new content. Future research should explore this concept to determine issues and solutions.

Teachers expressed difficulty deconstructing content in specialty areas; consistent with literature acknowledging expertise can impede teaching because experts forget what is easy and difficult for students (Bransford et al., 2000). Teachers emphasized the need to deconstruct content step-by-step, but didn't always know how to engage in this process. Step-by-step procedures assume learning occurs linearly. This could be contrary to inquiry based learning or other learning techniques. Exploration into the repertoire of methods beginning teachers have could uncover potential weaknesses or reliance on methods.

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Undergraduate Student Course Engagement and the Influence of Student, Contextual, and Teacher Variables

Adam A. Marx, North Dakota State University
Jon C. Simonsen, University of Missouri
Tracy Kitchel, University of Missouri

Introduction

Engagement is a student's connection to their learning environment, which describes the student's psychological processes and physical activities during a class session (Fredricks, Blumenfeld, & Paris, 2004; Newmann, Wehlage, & Lamborn, 1992). Student engagement needs significant consideration to better understand student behavior and address student needs (Christenson et al., 2008). Students' perceptions of their engagement in their courses can provide instructors with data to more clearly describe behaviors within the classroom (Handelsman et al., 2005; Mandernach, Donnelli-Sallee, & Dailey-Hebert, 2011; Svanum & Bigatti, 2009). Describing the antecedents of student engagement including contextual, student, and teacher variables, could assist course design and instructional decision-making for college teachers. The more instructors know about what students perceive, the better able they will be to shape the learning environment. Thus, it is important to describe the perceived engagement of students and determine the variables which encourage that engagement.

Review of Literature

Student course engagement is comprised of four unique factors: skills, emotional, participation/interaction, and performance engagement (Handelsman et al., 2005). Classroom engagement implies students take an active role in their learning (Barkley, 2010). Engaged learning leads to higher levels of interest in the subject matter and higher levels of academic effort by the student (Miller, Rycek, & Fritson, 2011).

On the other hand, disengagement has its consequences. Relative to test grades, Handelsman et al. (2005) reported lower levels of course engagement resulted in lower midterm and final test scores in freshman mathematics classes. Students not engaged in their schooling and the process of their post-secondary education put themselves at risk to inadequately acquire the knowledge and skills needed for their future (Miller, Rycek, & Fritson, 2011). An issue facing the literature in student engagement is that the distinction between the antecedents, state, and consequences of engagement is not often made (Kahu, 2013). Although there are data describing student engagement in college (Kuh et al., 2005; Rocca, 2010; Zepke & Leach, 2010), instructors still describe perceived characteristics of disengagement and student apathy in the classroom (Jonasson, 2012; Kahu, 2011; van Uden, Ritzen, & Pieters, 2014).

Some researchers (Garrett, 2011; Jonasson, 2012) suggest that student engagement is really about the progression of relationships in the learning environment. One area associated with student-teacher relationships is teacher immediacy behaviors. Immediacy behaviors elicit behavioral and cognitive responses to social interactions (Mehrabian, 1972) and include: facial expressions, eye contact, gesturing, tone of voice, word choice, and questioning strategies.

Immediacy behaviors are linked to students' perceptions of learning and learning motivation (Christophel, 1990; Frymier, 1994; Velez & Cano, 2008; 2012). Due to the similar dynamics of engagement and teacher immediacy, credibility is lent to a more substantive evaluation of the impact of teacher immediacy on student engagement. In the literature, there is little empirical evidence connecting teacher immediacy and student engagement.

Framework

The framework was founded in student engagement and immediacy. Figure 1 details the interaction between the considered independent variables identifiable in the classroom. Student course engagement is the outcome for the present study. Class size, course status, class time, and student rank were considered the *covariates* within the present study because each variable is represented in literature as influential on student engagement. Teacher verbal immediacy and nonverbal immediacy behaviors were considered the variables of interest for the present study, as they are believed to impact student engagement in the classroom.

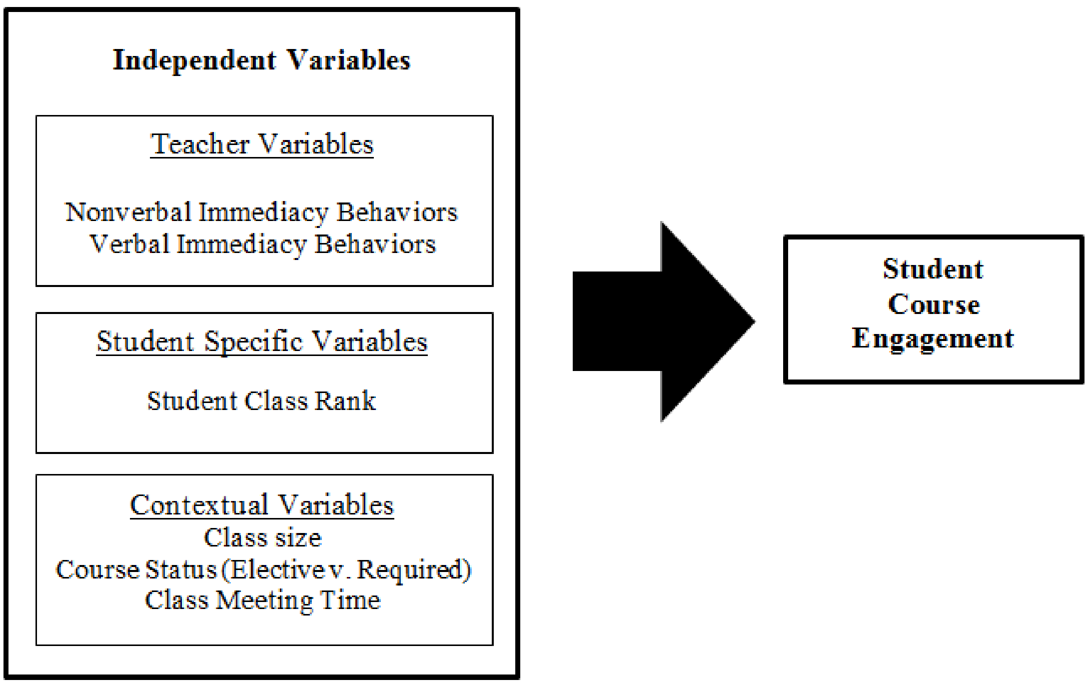

Figure 1: A Framework for Student Course Engagement

Purpose and Objectives

The purpose of this study was to examine the relationship between undergraduate student course engagement and independent variables including teacher verbal and nonverbal immediacy behaviors, college course status, class time, class size, and student class rank. The present study addressed the AAAE National Research Agenda as the authors sought to further understand effective teaching and learning processes in post-secondary environments (Doerfert, 2011). The following objectives aimed to:

1. Describe undergraduate student course engagement.
2. Describe students' perceptions of teacher nonverbal and verbal immediacy behaviors.
3. Describe the four covariates (e.g. class time).
4. Describe the contribution of teacher immediacy behaviors and the four covariates toward course engagement.

Methods

The descriptive-relational study had a target population consisting of undergraduate college students enrolled in courses within the College of Agriculture at the University of Missouri during the spring semester of 2014. A convenience sample of 359 students enrolled in three courses within the college of agriculture at University of Missouri, 300 students completed instruments. The average age was 20.4 years and most students were juniors (34.6%, n = 103). More females (54.0%, n = 161) were represented than males (46.0%, n = 137) and students reported 28 unique majors.

Survey design was utilized where students completed a paper questionnaire to acquire their perceptions. Consistent with previous work (Gorham, 1988; Velez & Cano, 2008), students reflected upon their engagement and instructor from the course immediately preceding the classroom in which the questionnaire was completed during week 12 of the semester. This method inherently increased the scope of courses and instructors for the study. A five-point scale was utilized to measure student course engagement and teacher immediacy behaviors. Hierarchical regression analysis was performed. Assumptions were tested and satisfied for operationalizing regression analysis (Field, 2009). Non-response error was not calculated or considered because generalizability was not the intent of this study.

The Student Course Engagement Questionnaire (SCEQ) focused on engagement at the course-level (Handelsman et al., 2005). The Nonverbal Immediacy Behaviors (NIB) and Verbal Immediacy Behaviors (VIB) instruments assessed student's perceptions of the frequency they observed the teacher demonstrating the specific behavior. Previous research utilizing the SCEQ (Handelsman et al., 2005), NIB (Titsworth, 2004), and VIB (Velez & Cano, 2008) reported Cronbach's alphas ranging from .76 to .94 for each construct within each instrument.

Findings

Objective One

Student course engagement was reported as total engagement and the four unique engagement factors. Students' mean for total engagement was 3.39 (SD=0.61). The highest mean was the performance factor (M=4.00, SD=0.81). Students reported the lowest engagement factor mean (M=2.91, SD=0.84) was related to their participation/interaction within the course reported.

Objective Two

Respondents were asked to reflect upon the teacher who led the course selected for objective one. According to the instrument scale, students perceived their teacher *occasionally*

(3.0) utilized verbal immediacy behaviors (M=3.01, SD=0.71) and nonverbal immediacy behaviors (M=2.99, SD=0.32) in the classroom.

Objective Three

Students were asked to report on personal and course-related variables. Two hundred fifty-three students (85.5%) reflected on a degree-required course and 43 (14.5%) reported on an elective course. Over half (52.4%, n=157) of the respondents reported on morning courses. Students most frequently reported data for this study based on their enrollment in courses with a population of students ranging from 1-29(n=103).

Objective Four

Hierarchical regression was utilized to explain the unique variance in engagement. Skills engagement regressed against the four covariates (e.g. class time) in the first block of the model resulted in non-significant. With the exception of emotional engagement, the initial model was significant for total, participation/interaction, and performance engagement. Class size was the sole significant predictor for total engagement (t=3.43), participation/interaction engagement (t=5.33), and performance engagement (t=2.70).

The addition of verbal and nonverbal-immediacy behaviors to the second block (See Table 1) produced a significant model for total (R^2_{adj}=.14), emotional (R^2_{adj}=.07), participation/interaction (R^2_{adj}=.25), and performance engagement (R^2_{adj}=.04). Verbal-immediacy behaviors significantly predicted: total engagement, emotional engagement, and participation/interaction engagement.

Table 1
Hierarchical Multiple-Regression of Engagement on Covariates and Immediacy(n=300)

Engagement Factor	Variable	B	*B*	t	*d*	*F(df)*
Total	Constant	2.11		6.14	.73	8.54*(6,285)
	VI	.27	.31	4.67*	.55	
	NVI	.15	.08	1.27	.15	
Skills	Constant	2.68		6.60	.78	1.93(6,285)
	VI	.12	.12	1.73	.21	
	NVI	.19	.09	1.34	.16	
Emotional	Constant	1.84		3.38	.40	4.73*(6,285)
	VI	.37	.28	4.12*	.50	
	NVI	.08	.03	.44	.05	
Participation/Interaction	Constant	1.17		2.64	.31	17.22*(6,285)
	VI	.47	.40	6.44*	.76	
	NVI	.10	.04	.67	.08	
Performance	Constant	2.72		5.66	.67	3.03*(6,285)
	VI	.13	.11	1.56	.19	
	NVI	.25	.10	1.53	.18	

Note. *p<.05, VI=verbal-immediacy, NVI=nonverbal-immediacy

The author failed to accept the null hypothesis in favor of the alternative hypothesis for total, emotional, participation/interaction, and performance engagement. Teacher verbal and nonverbal-immediacy behaviors explained a significant proportion of additional variation after controlling for the potential covariates.

Discussion

A limitation was the findings cannot be inferred beyond the sample because it was a single snapshot of a conveniently sampled group. In objective one, student perceptions of their engagement are seated squarely in the middle ground. The perception by some college teaching staff of student apathy and disinterest (Delucchi & Korgen, 2002; Jonasson, 2012; Kahu, 2011; van Uden, Ritzen, & Pieters, 2014) may be warranted. Students may not be comfortable interacting with their instructors or collaborating with classmates. Barkley (2010) suggests incorporating active learning opportunities within the classroom. Additionally, structured group activities can encourage students to consider multiple viewpoints.

In objective two, according to the students their teachers are neither immediate nor not immediate. Some teachers are likely highly immediate while others less frequently display immediacy. This implies there is room for improvement in the frequency teachers express immediacy behaviors (Frymier, 1994; Kearney, Plax, Smith, & Sorensen, 1988). Teachers may pay close attention to their variety of gestures, eye contact, and movement around the classroom to enhance nonverbal perceptions. Teachers may initiate more conversations, use inclusive language, and personalize course material to heighten perceptions of verbal-immediacy.

In objective three, most students reflected on degree-required courses indicating the need to further divide the choices for this variable for greater differentiation. As degree plans are reduced toward 120 total credits, nearly all courses within a degree plan could be considered required from the students' viewpoint. Over one-third of the respondents reflected on courses enrolling less than 30 students. This finding implies students are gaining exposure to courses fostering an engaging environment (Rocca, 2010), even in a large institution. Small classes foster greater student engagement (Cotton, 2000) in addition to teacher connection (Finn, Pannozzo, & Achilles, 2003).

In objective four, it was concluded that significant relationships existed between engagement and verbal immediacy behaviors. Their unique contribution and significance indicate teacher immediacy has a place in explaining part of undergraduate student course engagement. The influence of verbal and nonverbal immediacy behaviors on student course engagement further substantiated evidence of the role teachers play involving students in learning (Frymier & Houser, 2000; Garrett, 2011; Velez & Cano, 2008). It is therefore implied, the more immediate the teacher is, the more inviting and engaging the classroom environment she creates. College teachers should be aware of the manner they talk to their students, individually and as a class. Teachers who demonstrate energy and concern for student learning through being inclusive, encouraging, and realistic with communicating expectations can positively influence student course engagement (Barkley, 2010).

It can be concluded from these findings that class sizes of 29 students or less have a positive influence on student's total course engagement, participation/interaction engagement, and performance engagement. Although it may not be practical to reduce every class to 30 or less students, engagement benefit could be gained by grouping students to facilitate discussion in large lecture courses to facilitate the opportunity for teachers to approach students more directly and intimately. This would theoretically increase student positive perceptions of teacher immediacy.

Future studies should explore the tipping point of influence class size has on student engagement. Weaver and Qi (2005) purported class sizes of 30 or fewer produced more engaged students but, is there significant differences between 30 students and 50 students? Incorporating observations of student behaviors where the SCEQ is utilized could provide instructors with a better understanding of differences between what they observe and what students perceive. Thereby providing context to the question; are student behaviors indicative of their engagement?

Qualitative inquiry would allow students to describe in their own words what engagement looks like to them and better contextually define engagement. Plausibly, much additional interference to student engagement exists within the classroom. What is the role technology-use plays in student course engagement? What role does student use of personal devises during class-time play in engagement?

The development of online courses exceedingly increases as institutions seek to make education more accessible. Although literature exists regarding engagement in online courses, how can a teacher transmit immediacy remotely? The transferability and impact of teacher immediacy via online courses to students should be studied to facilitate engaged online learning.

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Utilizing the Tuning Protocol to Generate Peer Feedback During Lesson Plan Development: The Student Teachers' Perspective

Thomas H. Paulsen, Iowa State University
Taylorann K. Smith, Iowa State University
Ryan G. Anderson, Iowa State University

Introduction

Limited research has been conducted on the instructional planning process during student teaching in agricultural education (Greiman & Bedtke, 2008). An essential role of teacher preparation programs is to inform pre-service teachers of the importance of instructional planning and to develop them into effective instructional planners (Baylor & Kitsantas, 2005). Being an effective instructional planner relies heavily on the degree pre-service teachers feel capable of designing an instructional plan as well as their cognitive and metacognitive abilities (Baylor & Kitsantas, 2005; Driscoll, 2000; Reiser & Dick, 1996).

"Teacher [preparation programs] attempt to sort out which factors contribute to developing pre-service teachers and which factors may undermine their development" (Knobloch, 2006, p. 36), particularly the self-efficacy and confidence of pre-service teachers' teaching ability. Self-adequacy during the student teaching experience is high on the list of concerns expressed by student teachers (Fritz & Miller, 2003; Ng, Nicholas, & Williams, 2010) and it is that factor, in combination with others, that sparks motivation to engage in effective instructional planning (Baylor & Kitsantas, 2005).

Self-adequacy concerns are often experienced by pre-service teachers and have an influence on the teachers' ability to teach in the classroom (Fritz & Miller, 2003). Lesson plan design and development has often been a concern of beginning teachers (Greiman & Bedtke, 2008; Veenman, 1984). With this concern in mind, what are ways teacher educators can build pre-service teacher self-adequacy with respect to instructional and assessment strategies?

Conceptual Framework

This study is based on the conceptual frameworks of Easton (2009), and Allen and McDonald (1993). Tuning Protocols were created by David Allen and Joseph McDonald at the Coalition of Essential Schools (Easton, 1999). Protocols used in education serve as a structural guide for groups of educators to formally reflect and provide peer feedback regarding the planning and implementation of instructional strategies that best meet the needs of their students (Breidenstein, Fahey, Glickman, and Hensley, 2012; McDonald et al., 2007).

Breidenstein et al. (2012), defined tuning protocols as a "structured process that allows a teacher to gather the multiple perspectives of colleagues on a piece of work for the purpose of improving it, refining it, or bringing it more "in tune" with her stated goals or purposes" (p. 35). Many times pre-service teachers do not anticipate the challenges which will be presented as they enter the classroom. By using honest feedback from professional peers to assist them in identifying errors in planning, pre-service teachers can make corrections prior to implementing a lesson or teaching strategy. This open and honest conversation can build professional habits that encourage further inquiry and reflection (McDonald et al., 2007).

To meet the needs of pre-service teachers in this study, the Easton (2009) tuning protocol was adapted by decreasing the 60-minute protocol to 20 minutes per presenter and is shown in Figure one.

20 Minute Lesson Plan Tuning Protocol		
Presentation	Presenter shares the problem or draft of the plan currently under development and provides relevant information about efforts to date	5 minutes
Clarifying Questions	Group asks clarifying questions of the presenter. Solutions are not yet offered.	2 minutes
Silent Idea Generation	Members write down ideas or suggestions	3 minutes
Group Discussion	The group discusses ideas and solutions. The presenter listens and records suggestions.	8 minutes
Reaction	Presenter reacts to any responses he or she chooses. This is their opportunity to reflect upon new ideas they received.	2 minutes

Figure 1. Tuning Protocol Procedure adapted from Easton, 2009.

Purpose and Objectives

The purpose of this mixed method research study was to determine student teacher perceptions of the utilization of a tuning protocol when using peer review to revise lesson plans. This study aligns with the American Association for Agricultural Education Research Priority Area 4: “Meaningful, Engaged Learning in All Environments: examine the role of motivation, self-regulation, metacognition, and/or reflection in developing meaningful, engaged learning experiences across all agricultural education contexts” (Doerfert, 2011, p. 9). The following objective was sought: Determine student perceptions of tuning protocol utilization during the student teaching experience.

Methodology

The population of this study consisted of agricultural education pre-service teachers (N=21) from Iowa State University who participated in the capstone student teaching experience during the fall of 2013 and spring of 2014. Student teachers were introduced to the tuning protocol during the on-campus, mid-semester professional development meeting. Pre-service teachers were asked to identify and provide copies of an implemented lesson plan which needed improvement along with accompanying student work to their peers during the mid-term and final student teaching meetings. Given the printed protocol and verbal instructions, pre-service candidates were randomly assigned to a group of three. One person was designated as the presenter while the other two served as peer reviewers/participants. Graduate students or university faculty members facilitated each group and acted as the official timer.

Much like the preconference observation in the clinical supervision cycle (Goldhammer, 1969) the student teacher began the tuning protocol process by identifying and sharing an area of concern from a previously implemented lesson for which guidance and advice was needed. A brief overview of the lesson was presented which included the background, setting, objectives, teaching strategies, and examples of student work. During the initial presentation, peers took notes and silently reflected upon the peer's scenario.

Next, two minutes were allowed for peers to ask clarifying questions. Feedback was not given during this stage. Immediately following the clarification stage, three minutes were provided for group members to silently reflect and provide written feedback for the presenter. Group discussion followed the silent idea generation stage. For eight minutes, the presenter listened and took notes as group members provided feedback and engaged in discussion regarding lesson improvement. In the final stage, two minutes were provided for the presenting student teacher to reflect upon and react to the peer feedback. Final thoughts about how the lesson could be improved in the future were written and shared. The twenty-minute tuning protocol session was then repeated with the remaining group members.

Student teachers were asked to answer an open-ended question upon completion of the tuning protocol and peer reflection experience: What are your perceptions of utilizing the tuning protocol? Student teachers responded in a private group housed in the NAAE Communities of Practice.

Each response on the NAAE Communities of Practice was copied to a word document to be kept anonymous. Open coding was used to begin to "[identify] themes or categories that seem[ed] of interest" (Esterberg, 2002, p. 158). After the responses had been read twice at a two-week interval, recurring themes emerged regarding the use of the tuning protocol: 1) benefits, 2) drawbacks, 3) structure and format, and 4) recommendations for future implementation. Statements were designated as *Benefits* when the student teachers proclaimed to have gained a positive experience; *Drawbacks* when students had a negative experience; *Structure* was coded when one of the components was listed; and *Future Implementation* responses were coded when students offered suggestions for further implementation. Intrarater reliability was determined to be high ($\alpha = .94$) (Ary, Jacobs, & Sorensen, 2010). A mixed method approach allowed for both depth and breadth to guide the researchers in understanding the student teacher perspectives (Johnson, 2014). The mixed method approach was needed to analyze and interpret qualitative data that emerged through thematic coding while quantitative methods were used to determine response frequencies.

Results

Table 1 depicts example responses for each theme that emerged. Student teachers responded most frequently regarding the *Benefits* of the tuning protocol process. Response frequencies and percentages are displayed in Table 2.

Table 1

Thematic Coded Responses for the Tuning Protocol Process

Themes	Example Responses
Benefits	*[The tuning protocol] forces me to actually come up with questions and ideas to present to my peers in the small group discussion.* *I have learned the importance of peer review.* *Group work is great and I think it gives a better final product.* *It allows us to look at our lesson designs and how we can improve on them to help better serve our students.*
Drawbacks	*I prefer the more informal discussion that occurs when teachers give each other ideas for improvement.* *Not sure if this activity was beneficial to me at the current moment- I am unaware if I will be teaching these lessons in the future.* *I think we could get it done in a lot less time, except when we veer off and talk about experiences.*
Structure	*The only thing I would change would be to shorten the time for discussion and more time using clarifying questions.* *I enjoyed the layout because it made me think about how to make the lesson better.* *I like how it is set up with timed parts of discussion, idea generation, and questions.* *I think it's beneficial to have the time structure and to actually stick to it*
Future Implementation	*This would also be great for undergrads….so that their peers can critique it before they ever even teach the lesson I feel the spring student teachers should do this before they go into student teaching* *It would be nice if we had the ability to put this on [Communities of Practice] throughout the semester to get some feedback…*

Table 2

Open Coded Responses for Student Teacher Perception of Utilizing the Tuning Protocol

	Fall 2013 (N = 9) Total Responses = 44[a]		Spring 2014 (N = 12) Total Responses = 65[a]	
Themes	*f*	%	*f*	%
Benefits	28	63.6	34	52.3

Drawbacks	2	4.5	12	18.5
Structure	4	9.1	15	23.1
Future Implementation	10	22.7	4	6.2

Note. [a] Total responses represent all responses given by student teachers, all students gave more than one response.

Conclusions and Discussion

Pre-service teacher candidates found peer feedback beneficial when reflecting on previously implemented lesson plans. Feedback was generated to provide for future improvement of lesson design, implementation, and the impact of teaching. Easton (2009) stated that the tuning protocol can provide an environment for professional discussion that encourages "…groups to explore ideas deeply through student work, artifacts of educator practice, texts relating to education, or problems and issues that surface during the day to day lives of educators" (p. 8).

One student teacher expressed the concern to better serve her students. By recognizing concerns and tailoring educational materials through the tuning protocol, pre-service teachers can more effectively influence student achievement (Fuller and Brown, 1975; Stair, Warner, & Moore, 2012). Another student stated, "Through this protocol, I have learned the importance of peer review." Several studies have noted positive effects of pre-service peer-evaluation (Ozogul, Olina, & Sullivan, 2008).

Implications

This study is limited to the student teachers who participated; however it serves as contribution to the body of research regarding instructional planning during the student teaching experience. Though the responses deem the tuning protocol to be a beneficial tool, it is important to closely examine drawbacks noted by student teachers. Easton (2002) suggested that the tuning protocol can be adapted to fit specific needs. One student stated "Not sure if this activity was beneficial to me at the current moment—I am unaware if I will be teaching these lessons in the future." During further implementation, student teachers should be informed that the tuning protocol can be used for educational problems beyond lesson design improvement. Though lesson plan improvement is a focused outcome, it is also important that students learn how to effectively collaborate with their peers which is a critical part of professional development (McDonald et al., 2007).

"Teachers seek out one another for advice and feedback, and not just in the formal processes of the tuning protocol" (Easton, 2002, p. 30). With this in mind, time for collaboration during the student teaching experience must be set aside for student teachers to have the opportunity to collaborate with one another. Upon further implementation of the tuning protocol, teacher preparation programs will be able to assist pre-service teachers in building confidence in lesson plan and activity design. With this confidence, agricultural educators will be able to better motivate future generations of learners in agricultural education.

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