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Assessing Undergraduate Needs Within Online Learning Management Systems in Colleges of Agriculture

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Abstract

The internet has served as the basis for online learning for the past 30 years. Learning management systems have become a primary focus of public and private universities as the next generation of college students expect open and unfettered access to their education. The purpose of this Delphi Study was to investigate the instructional needs of undergraduate agriculture students enrolled in online learning environments at a midwestern College of Agriculture. Two research questions guided this investigation, (1) what are the essential components for an effective undergraduate online learning management system and (2) what are stakeholder perceptions of learning management system design, development, coursework, and design themes? Using the Delphi Model for consensus an undergraduate panel (N = 10) was convened to identify the vital components for learning management systems which addressed instructional design, application of course content, and student collaboration education within online learning platforms. Undergraduate panelists indicated the need for faculty to have professional development opportunities to improve their design and implementation of online learning and an expert in LMS design and course delivery to answer questions and aid in the course development process. Undergraduates at Colleges of Agricultural Science should be provided extended or foundational training in major aspects of online course enrollment including course use and access, communication functions to enhance student and faculty collaboration, more robust formative assessment opportunities for online learning, lesson adjustment, and improved multimedia in the course assignments.

Keywords: agriculture, distance-based education, learning management system, perceptions of online programs, student learning, undergraduate education

Introduction

The United States is at a remarkable moment in the history of higher education in online-based learning (Larreamendy-Joerns & Leinhardt, 2006). Valentine (2002) noted that the history of distance education has existed for more than 100 years. As reported by Volery and Lord (2000) distance education was originally intended to cater to disadvantaged students existing in areas where proximity to higher learning institutions was limited. To counter the debilitating effects of education deserts (Myers, 2018) online learning has the promise to serve the 11.2 million adults without access to on campus learning. Roberts and Dyer (2005) reported that teaching and learning and the delivery of content in an online learning environment can take many forms and utilize many learning activities. Keegan (1995) defined distance education saying “distance education and training result from the technological separation of teacher and learner which frees the student from the necessity of traveling to a fixed place, at a fixed time, to meet a fixed person, in order to be trained” (p. 7). Chumbley et al. (2018) reported that for students to advance and achieve their goals, they must be successful in various educational learning environments. Harasim (2000) indicated the development of online course delivery made education increasingly accessible allowing new instructional models to emerge. Alqurashi (2018) supported the importance of accessibility while meeting the increasing number of student enrolling for distance education opportunities.

Learning management systems have become a primary focus of public and private universities as the next generation of college students expect open and unfettered access to their education. Chumbley et al. (2018) reported the past 20 years have witnessed dramatic changes in student learning opportunities and Larreamendy-Joerns and Leinhardt (2006) addressed the importance of higher education in regards to online-based learning. The inconsistencies of web-based learning modules and appropriate preparation of content design have demonstrated a misapplication of best practices for teaching and learning in online forums. Two barriers are commonly inherent to online education. Student interest and course development of online learning modules present specific challenges. As technology becomes smaller, affordable, and more accessible online education platforms are natural pathways for current and future students to access instructional opportunities. Strong et al. (2013) reported that the increasing use of mobile platforms for instruction is changing the traditional style of learning while creating new and innovative teaching and delivery methods. The role of teaching and learning in agriculture-based classrooms and the delivery of content in online learning environments can take many forms and utilize varied learning activities (Roberts & Dyer, 2005). Course delivery (Allen & Seaman, 2004) has evolved to meet the trend of university campuses offering courses online or utilizing a blended approach. Allen and Seaman (2013) also support online course delivery and noted a 400% increase in online learning courses in the past decade. The availability of learning management systems as a course delivery platform combined with interest in lifelong learning has created a significant incentive for universities to develop online programs (Volery & Lord, 2000). Online education is invaluable for students regardless of location, cultural, personal economics, or politics on a global scale. Rumble (2001) reported that from 1971-2001 distance education had changed tremendously due to five factors: technology, pedagogical shifts from transmission towards a constructivist model, the growing acceptance of distance education, perception, and the focus on the student as a consumer of learning. These factors highlight the need for the distance education learning management systems while recognizing the changing role of the student as both equal parts consumer and creator of content.

Learning management systems have established the availability of economical platforms to access educational content. The emphasis for academic preparation has only recently shifted from preparing all students for post-secondary education to a focus on college and career readiness (Barnes et al. 2010). This evolution of practice has focused the design and implementation of distance education platforms. Lowerison et al. (2006) discussed the availability of online education provides undergraduate agriculture students the opportunity for college credit and a computer-based setting which emphasizes a multitude of instructional methodologies tailored to the individual student. This flexibility supports the popularity of online courses (Muljana & Luo, 2019) and the benefit of reducing training costs for businesses (Lee & Choi, 2011). As a result of the availability of technology students are gravitating towards less restrictive and more transparent avenues for their formal and non-formal education.

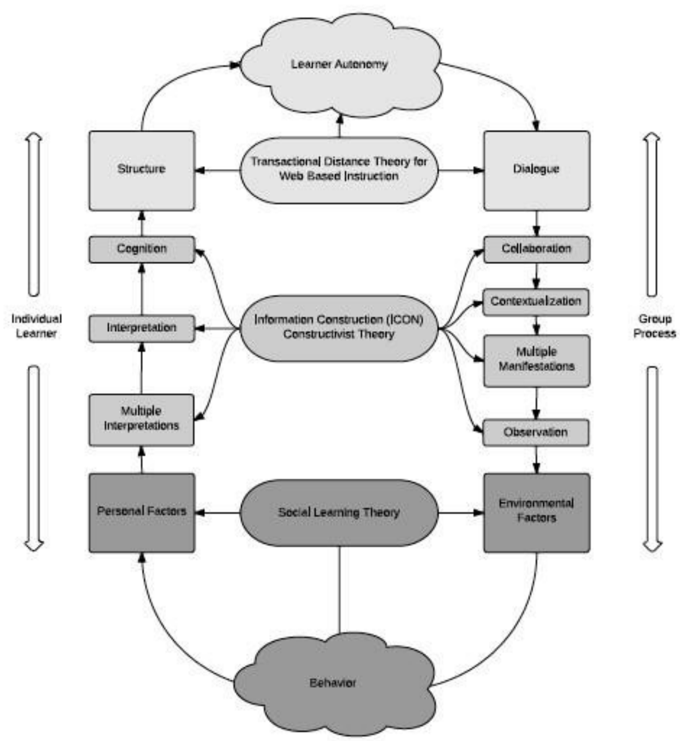
Theoretical Framework

The theoretical framework for this study was structured using Moore's Transactional Distance Theory for Web-Based Instruction (1993), Black and McClintock's (1996) Constructivist Learning Model for Information Construction, and Bandura's (1997) Social Learning Theory. Moore's Transactional Distance Theory (1993) addresses the relationship between instructor and student in the e-learning environment where student and instructor are separated in both physical and location presence. Moore (1993) defined Transactional Distance Theory as "the psychological or communicative space that separates instructor from learner in the transaction between them, occurring in the structure or planned learning situation (p. 1). Jung (2001) defined Transactional Distance Theory as a pedagogical relationship in the environment of distance education. Moore (1993) identified the conception of transaction originating from John Dewey and explained by Boyd and Apps (1980) "transaction describes the interplay among the environment, the individuals, and the patterns of behavior in a situation" (p. 5). Moore (1993) identified two variables within Transactional Distance Theory where dialogue is the "interaction between the teacher and learner where one gives instruction and the other responds" (p. 4). And communication is determined by a number of instructional factors which represent the personalities of the teacher and the learner, the subject matter of the course, and environmental factors within the realm of instructional delivery. Jung (2001) further describes three elements required for distance education programs: dialogue, structure, and learner autonomy. Jung (2001) citing Moore and Kearsley (1996) identified learner autonomy as the extent to which learners make decisions about their own learning and construct knowledge based on their own experience. Moore's (1993) second variable described the transactional distance effect which are the elements of course design. Moore (1993) identified course design elements as the extent to which the course is structured in relation to the mode of instructional delivery being utilized. Moore (1993) described the element of structure as the degree of rigidity and flexibility of program objectives, teaching strategies, and evaluation methods. The role of the individual learner is also identified within the structural component by accounting for the degree of flexibility the program possesses for individual learning needs.

Black and McClintock (1996) proposed the Constructivist Learning Model for Information Construction approach related to constructivist design as an interpretation of authentic artifacts in the context of background materials. Black and McClintock's approach is observation based with authenticity at the core of student learning the application for online teaching and learning is applicable, as technology has allowed for the design of more authentic and practical experiences for distance education students. Bandura (1977) reported learning by direct experience would lead to new patterns of behavior being acquired through direct experience by observing the behavior of others. Bandura (1977) stated that through experiences the reinforcement of consequences serves as a means for informing learners what must be done to gain beneficial outcomes or avoid less favorable results. This theory is effective in the development of online learning frameworks. Favorable experiences through modeling or coaching of best practices in online learning would reinforce the desired level student interaction through the learning management system. Hislop (2006) supports the effect of experience as a measurable outcome of desired behavior as learning is inseparable from the day-to-day practices student's carry out in studies and work.

Bandura (1977) identified three components of Social Learning Theory: personal factors: knowledge, expectations, and attitudes. Environmental: social norms, access in community, influence on others, and behavioral: skills, practice, self-efficacy. Bandura (1977) reported the use of Social Learning Theory would encourage the learner to observe and imitate the behavior of others, see positive behaviors modeled and practiced, increase their own capacity for new skill acquisition, gain confidence in the implementation of new skills, and experience support from their environment to apply newly acquired skills. The confluence of Moore's Transactional Distance Theory for Web Based Instruction (1997), Constructivist Learning Model for Information Construction (Black & McClintock, 1996) and Social Learning Theory (Bandura, 1977) presents a proposed theoretical model for the development, implementation and reflection of both student and instructor. This model identifies the need for both students and instructors to participate in the group process as a measure of enhanced and best practice online course design and learning. The role of this model is to demonstrate the cyclical effect, whereas students, and instructors collaborate within the group process and proceed to the intrinsic level of concept and contextual understand as an individual. The student and instructor then work collectively within the larger group by sharing individual insights regarding the content being taught. Figure 1 illustrates the potential theoretical framework for student and instructor instructional processes.

Figure 1 *Theoretical Framework for Student Learning and Instructor Online Learning Processes*



Purpose and Research Questions

The purpose of this Delphi Study was to investigate the instructional needs of undergraduate agriculture students enrolled in online learning environments. To better understand online learning needs of undergraduates two research questions guided this investigation: what are the essential components for an effective undergraduate online learning management system, and what are stakeholder perceptions of learning management system design, development, coursework, and design themes?

Methods

This study used the Delphi method for collected data related to the purpose and consisted of a three rounds investigation process using undergraduate agriculture students as the research panel. Somerville (2007) reported the Delphi as an appropriate research instrument when information can be gathered from a wide geographical area representing a diverse panel of participants, a desire for respondent anonymity, and when respondents have time to carefully consider their responses. Delp et al. (1977) in Dyer and Breja (2003) described the Delphi method as a group process used to solicit, collate, and direct responses toward reaching a consensus. Helmer (1967) reported the Delphi technique as a method of securing and refining group opinions and substituting computed consensus for an agreed-upon majority opinion. A review of the available literature revealed no appropriate Delphi study instrument available to measure undergraduate agriculture students' perception and needs of learning management systems. The instrument was organized in five areas of interest: (1) instructional design components for effective online learning, (2) online learning at Colleges of Agriculture, and (3) perceptions of online learning. The pilot test was conducted with 44 ($N = 44$) post-secondary agriculture students previously or currently enrolled in at least one online course at Southern Illinois University in the College of Agricultural Sciences. The population of the pilot study was representative of the panelists but were not included in the reporting of the finalized instrument. The pilot study response rate was 50.0%. Students were asked to provide input for the revision of test items which were ambiguous, grammatically flawed, or reflective of researcher bias. Chronbach-alpha indicated $\alpha = .857$ measure of internal consistency which was appropriate for assessing validity. At the conclusion of the pilot test the results were analyzed by the researcher and agricultural education faculty at Southern Illinois University to review recommendations and ensure accountability to the research objectives, language, and validity. The amended pilot study was returned to the pilot review panel for interrater reliability assessment. The instrument was then distributed to the undergraduate agriculture student panelists.

The selection of undergraduate agriculture students was determined using multiple strata. Panelists met meet the following requirements for inclusion in the study: undergraduate students enrolled in at least one online (asynchronous) course, junior or senior level class standing, self-identified course grade average equal to or greater than 3.00, a member of the Southern Illinois University Collegiate FFA, and declared as a College of Agricultural Science major. The rationale for selecting undergraduates enrolled in online coursework was their familiarity with the learning management systems and their role as direct stakeholders in the use and design of online coursework. The frame for this study consisted of 550 junior and senior students across all majors in the College of Agricultural Sciences at Southern Illinois University (*N* = 550) with the panel consisting of 10 (*n* = 10) panelists and represented three departments in the Southern Illinois University College of Agricultural Sciences: Animal Science, Food, and Nutrition (AFNR), Plant, Soil, and General Agriculture (PSGA), and Agribusiness Economics (ABE). Undergraduate panelist selection data was obtained by assigning a numerical value to each of the selection variables in Table 1. Variable one identified the student's major, variable two represents the students' level in undergraduate education, and variable three indicates self-reported GPA. Self-reported GPA was used instead of institutional GPA as a limitation of available data from the Registrar's office. Variable four represented participation in the Collegiate FFA (as a measure of engagement and leadership in the College of Agriculture), and variable five identified the number of online courses the student has completed. Values were assigned to each variable to determine inclusion in the panel.

Table 1

Criteria for Selection of Undergraduate College of Agricultural Sciences Students (N = 10)

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Variable		ANFN	PSGA	ABE	ANFN	PSGA	ABE	ANFN	PSGA	PSGA PSGA
V2	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00
V3	2.96	3.18	3.14	2.83	3.00	4.00	3.16	4.15	3.04	4.00
V4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		5.50	6.50	6.00	6.00	5.00	6.60	5.50	5.00	6.00
Mean V2-V5		3.42	3.66	3.45	3.50	3.50	3.29	3.66	3.01	3.50
V5	8.00									
	3.74									

Note. S^{1-10}= student, Var. = undergraduate agriculture major, V^{2}=junior/senior, V^{3}=GPA ≤ 2.80, V4 =COAS Collegiate FFA member, V^{5}=average of enrolled online COAS courses.

A mean score of ≤ 2.80 was used to select the final ten participants. Participants were contacted through email for recruitment purposes in the Delphi Study and for ensuring a more personalized approach for attracting and retaining the panelists. Dillman, Smyth, and Christian (2009) extol the virtue of personalized requests through email to establish a connection between the researcher and the respondent to invoke social exchange and draw respondents out of the group setting. Participants were asked to respond through email with their willingness to accept or decline the invitation. The Delphi process consisted of three rounds and data was collected using interval measurement scales and group consensus. The first-round instrument consisted of 29 closed-ended statements using the following scale: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, and 5=strongly disagree. Round two statements were categorized in three areas as a result of round one analysis: instructional design of the LMS, online learning at Colleges of Agriculture, and perceptions of online learning. Responses deemed to be similar in nature were combined into one unifying statement and categorized accordingly (Hasson et al. 2000). Participants were asked to rank order the statements in round three.

Findings

The findings of the study are presented by Delphi round. In round one participants were provided 29 closed-ended statements in three categories: instructional design, online learning at Colleges of Agriculture, and participant perceptions of online learning. Participants (n = 10) responses were analyzed form the statements provided. Undergraduate students were provided the instrument and asked to provide their level of agreement in each of the instrument areas. Research question one identified twelve essential statements. To better understand the instructional design components undergraduate students valued as essential to the improvement of online learning management systems student scores were evaluated using descriptive statistics (mean and median), and standard deviation. Participants reported their level of agreement based on round one statements (Table 2). In order for an item to reach group consensus, the item had to obtain a mean score of ≥ 4.5 or higher from the panelists.

Table 2

Round One Participant Responses Related to Essential Instructional Design

Item	Statement	*M*	*Mdn*	*SD*
A4	Students should be required to complete learning management system training modules prior to engaging in online coursework.	4.70	4.00	.48
A3	All Online learning software should be designed in a similar manner.	4.70	5.00	.48
A8	Online programs should be designed for ease of use by faculty for the purposes of uploading materials, discussion boards, video chat, and downloading assignments.	4.60	5.00	.51
A1	A video tutorial for effectively using the online learning management system would be beneficial for student use.	4.50	4.50	.52
A6	Learning management systems should contain options for students to identify their preferred learning style.	4.40	4.50	.69
A2	If a student identifies their preferred learning style, the learning management system should include learning modules, which reflect the students learning preference.	4.30	4.00	.48
A5	Online learning curriculum should allow for group problem solving and collaboration.	4.10	4.00	.73
A7	Online learning programs should be designed to engage students in authentic discussions and provide for accountability in their discussions.	4.00	4.00	1.0

Panelists identified (Table 3) the need for a video tutorial to effectively navigate the online learning management system would be beneficial for student use (A4), online programs should be designed for ease of use by faculty for the purposes of uploading materials discussion boards, video chat, and downloading assignments (A3), online learning programs should be designed to engage in authentic discussions and provide for accountability in their discussions (A8), and students should be required to complete learning management system training modules prior to engaging in online coursework (A1). Participants were provided eleven statements regarding online learning at Colleges of Agriculture.

Table 3

Panelist Response Regarding Online Learning at Colleges of Agriculture

Item	Statement	*M*	*Mdn*	*SD*
B11	Online learning modules should provide options for students to easily contact their instructor.	4.80	5.00	.42
B3	Faculty would benefit from an assessment of network and computer capabilities prior to designing online course.	4.70	5.00	.48
B5	Mobile and tablet applications for online learning should be developed in parallel to desktop/laptop hardware applications to allow students to more easily access coursework.	4.60	5.00	.69
B6	New and existing faculty should have opportunities for professional development workshops to increase their knowledge related to online teaching and learning.	4.60	5.00	.51
B4	Faculty should encourage students to use multiple forms communication (email, phone, text, social media) when using the learning management system to provide quality student service.	4.50	5.00	.70
B7	New and existing faculty would benefit from an easily accessible expert to provide guidance and support for the design and implementation of online learning modules.	4.30	4.00	.48
B9	The use of graphics, video, and charts should be included in the framework for developing online learning modules.	4.30	4.00	.48
B8	Online learners should be given a variety of assessments for completing assignments and culminating projects.	4.20	4.00	.63
B10	More rigorous lessons should be developed for online courses beyond the recall (memorization) level.	3.90	4.00	.56
B1	Online curriculum is developed at a level of learning far below curriculum used in the traditional classroom.	2.80	3.00	.78
B2	Traditional classroom content should be transferred to online B1 learning modules without any modification or formatting.	2.50	2.00	.97

Panelists indicated statements (Table 4) with a mean score of ≥ 4.5 as essential to online learning at Colleges of Agriculture. E-learning modules should provide opportunities for students to engage in relevant discussions with faculty guidance (B11), faculty would benefit from an assessment of network and computer capabilities prior to designing online coursework

(B3), mobile and tablet applications for online learning should be developed in parallel to desktop/laptop hardware applications to allow students to more easily access coursework (B5), new and existing faculty should have opportunities for professional development workshops to increase their knowledge related to online teaching and learning (B6), faculty should encourage students to use multiple forms of communication (email, phone, text, social media) when using the learning management system to provide quality student service as being the most essential components for effective online learning at the collegiate level (B4).

Table 4

Round One Panelist Response Regarding Principles of Online Learning

Item	Statement	*M*	*Mdn*	*SD*
C4	Faculty should inform/discuss expectations for online learning and responsibilities with students prior to the beginning of the online course.	4.60	5.00	.70
C5	Students should expect more self-responsibility and organizational skills while enrolled in an online course.	4.60	5.00	.84
C2	Student learning styles should be assessed and considered when designing online courses.	4.50	4.50	.52
C3	Formative assessments, which periodically check for student understanding, should be incorporated into all online learning modules.	4.40	4.00	.51
C7	Faculty lack time in their schedules to develop cognitively demanding curriculum focused instruction for online learning.	3.40	4.00	.84
C6	Faculty experience great frustration with the development, 3.30 implementation, and assessment of online course design and student engagement.		3.50	.95
C1	Universities should consider an additional fee to conduct 2.80 professional development for faculty to learn best practices related to online course/curriculum development.		2.50	1.4

Panelists indicated essential statements with means ≥ 4.5 related to their perceptions of online learning. Faculty should inform/discuss expectations for online learning and responsibilities with students prior to the beginning of the online course (C4), students should expect more self-responsibility and organizational skills while enrolled in an online course (C5), and student learning styles should be assessed and considered when designing online courses (C2). In round two participants were provided 12 statements from the round one instrument and asked to rank order each item according their perception of importance related to online learning management systems. Two statements were removed from the second-round instrument due to mean scores outside the established range. Students should expect more self-responsibility and organizational skills while enrolled in an online course (C5) and student learning styles should be assessed and considered when designing online courses (C2). Participants strongly agreed (Table 5) that online programs should be designed for ease of use (M = 3.40, $S.D.$ = 1.83) by faculty for uploading materials for student access. Participants also agreed that online learning programs (M = 4.00, $S.D.$ = 3.24) should be engaging for students and mobile applications (M = 4.80, $S.D.$ = 2.29) should be developed in parallel to the desktop LMS. Support was indicated for new and existing faculty (M = 4.90, $S.D$ = 2.29) to have professional learning opportunities to improve online course design and faculty should discuss expectations (M = 5.20, $S.D.$ = 3.42) for online learning with students prior to the beginning of the course. The use of a LMS video tutorial (M = 5.50, $S.D.$ = 3.24) for student efficiency and having an expert (M = 6.30, $S.D.$ = 2.66) to provide guidance support for instructional design within the LMS for faculty. Participants indicated their feelings supporting enhanced discussions (M = 6.60, $S.D.$ = 1.83) with faculty in the LMS and improved use of graphics, videos, and charts (M = 6.90, $S.D.$ = 3.47) to support instruction in the LMS. Panelists supported the need for increased formative assessment (M = 7.40, $S.D.$ = 1.64) to check for understanding of course material during instruction.

Table 5

Round Two: Undergraduate Hierarchical Ordering of Online Learning Needs

Item	Rank	Statement
A	1	Online programs should be designed for ease of use by faculty for the purposes of uploading materials, discussion boards, video chat, and downloading assignments.
C	2	Online learning programs should be designed to engage students in authentic discussions and provide for accountability in their discussions.
D	3	Mobile and tablet applications for online learning should be developed in parallel to desktop/laptop hardware applications to allow students to more easily access coursework.
E	4	New and existing faculty should have opportunities for professional development workshops to increase their knowledge related to online teaching and learning.
I	5	Faculty should inform/discuss expectations for online learning and responsibilities with students prior to the beginning of the online course.
B	6	A video tutorial for effectively using the online learning management system would be beneficial for student use.
G	7	New and existing faculty would benefit from an easily accessible expert to provide guidance and support for the design and implementation of online learning modules.
F	8	E-learning modules should provide opportunities for students to engage in relevant discussions with faculty guidance.
H	9	The use of graphics, video, and charts should be included in the framework for developing online learning modules.

J	10	Formative assessments, which periodically check for student understanding, should be incorporated into all online learning modules.

Round three data analysis (Table 6) presented choices for hierarchical order of online learning needs. The instrument for round three was created through the respondents' original rank order selection from round two. Each participant received a copy of their round two selections and the option to provide comments to justify any reorganization of their choices. Each panelist was asked to review their original selection and then review all comments related to each statement to determine whether their opinion of rank had changed. If a change was made participants indicated the new rank order. Participants were asked to consider a possible change in their round two rankings after reviewing aggregated principles from their respective panel. Mean scores for each statement were used to determine the most important and least important components for online course development. The response rate for round three was 100.0 percent (n = 10) and indicated a 70.0 percent change from round two.

Table 6

Panelist Group Comprised of Round Three Mean Scores of Items A-J

Item	Statement	*M*	*SD*
A	Online programs should be designed for ease of use by faculty for the purposes of uploading materials, discussion boards, video chat, and downloading assignments.	4.31	2.66
C	Online learning programs should be designed to engage students in authentic discussions and provide for accountability in their discussions.	4.13	3.04
I	Faculty should inform/discuss expectations for online learning and responsibilities with students prior to the beginning of the online course.	4.48	2.70
E	New and existing faculty should have opportunities for professional development workshops to increase their knowledge related to online teaching and learning.	5.48	3.13
F	E-learning modules should provide opportunities for students to engage in relevant discussions with faculty guidance.	5.60	2.24
J	Formative assessments, which periodically check for student understanding, should be incorporated into all online learning modules.	5.68	2.62
D	Mobile and tablet applications for online learning should be developed in parallel to desktop/laptop hardware applications to allow students to more easily access coursework.	5.80	3.09
H	The use of graphics, video, and charts should be included in the framework for developing online learning modules.	6.27	2.57

G	New and existing faculty would benefit from an easily accessible expert to provide guidance and support for the design and implementation of online learning modules.	6.48	2.70
B	A video tutorial for effectively using the online learning management system would be beneficial for student use.	6.75	2.90

Conclusions, Implications, and Recommendations

The purpose of this Delphi study was to investigate the instructional needs of undergraduate agriculture students enrolled in online learning environments in Colleges of Agriculture. A representative sample of undergraduate students (*n* = 10) enrolled in online coursework at Southern Illinois University were selected for participation to address the needs of online learners enrolled in agricultural coursework in an online environment. Research questions were designed assess the essential components for an effective undergraduate online learning management system and the identification and analysis of stakeholder perceptions of factors influencing the design, development, implementation of online coursework, and perceptions by instructional design themes. The results indicated that undergraduate students recognize the need for online programs to be designed for ease of use by students and faculty. This outcome reinforces Moore’s (1993) Transactional Distance theory of addressing the relationship between student and instruction and further supports Lowerison et al. (2006) that the individual needs of students should be considered when designing online courses. Undergraduates also value the use of mobile technology for online learning and the need for formative assessment of their progress during online course instruction. Strong et al. (2013) reported similar findings and the value mobile platforms have for innovation and changing the delivery models for university coursework.

Undergraduate panelists supported Bandura’s (1977) Social Learning Theory by indicating the need for faculty to have professional development opportunities to improve their design and implementation of online learning and an expert in LMS design and course delivery to answer questions related to course development. Bandura reported the importance of the learner to see the positive behaviors modeled, practices, and internal capacity improved. The continued improvement and development of appropriate coursework for agriculture majors should incorporate aspects of online teaching and learning. Future students will continue to match their skill level using technology to the abilities of hardware and software within their learning environment. Participants indicated the importance of video and interactive components and the importance of instructional videos available prior to the use of the LMS system. Black and McClintock (1996) are supportive of interactive learning environments to improve authenticity and practical experiences. This finding supports the analysis that students value online programs that are purposefully designed for uploading materials, discussion boards, video chat, and accessing assignments.

Findings indicated online learning systems typically are incomplete and do not meet the needs of the major stakeholders. A need exists to implement the findings of this study based on the needs of the students and faculty within Colleges of Agriculture. Undergraduates at Colleges of Agriculture should be provided extended or foundational training in major aspects of online course enrollment including course use and access, communication functions to enhance student and faculty collaboration, more robust formative assessment opportunities for online learning, lesson adjustment, and improved multimedia in course assignments. The use of the internet has existed in various forms for more than 30 years and will continue to reach individuals without access to higher learning opportunities. The expectations of undergraduate agriculture students and future agriculturalists will expect enhanced services through communication and interaction. Further discussion among educational theorists and agricultural educators would benefit student interaction and learning in an online environment. Opportunities exist to extend the use of the web-based learning program to become more than a repository for low engagement activities. The opportunities for faculty and students have never been more attainable. We stand at the precipice of a great revolution of learning just as educational visionaries, theorists, and countless others before our generation experienced. We must appreciate the past to meet the needs of the future.

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Prioritizing the Professional Development Needs of First-Year School-Based Agricultural Education Teachers Regarding Career Development Events

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Prioritizing the Professional Development Needs of First-Year School-Based Agricultural Education Teachers *Regarding Career Development Events*

Abstract

Identification of the professional development needs of secondary school teachers is critical to improve teacher capacity. Inservice and preservice school-based agricultural education (SBAE) teachers need a broad spectrum of professional development to be prepared for the variety of duties and expectations demanded of the position. This study used the Borich needs assessment model to identify and prioritize the professional development needs of first-year SBAE teachers in Oklahoma regarding their interest in and competence to train students in the various state-specific career development events (CDEs). Thirty-seven first-year SBAE teachers in Oklahoma participated in the study. The findings revealed that the teachers deemed all 27 CDEs to be important; although, they were not necessarily interested in teaching them all. The CDEs with the highest priority included Livestock Evaluation, Veterinary Science, Meats Evaluation and Technology, Food Science and Technology, and Agricultural Sales. As the agricultural industry and the educational sphere continue to change, so too must those who endeavor to serve in communities and teach agricultural education. As such, identifying, prioritizing, and ultimately addressing the needs of SBAE teachers must be ongoing and sustained over time.

Introduction

Identifying the professional development needs of secondary school teachers is critical for a multitude of reasons (National Council for the Accreditation of Teacher Education [NCATE], 2010). The identification of needs can improve the capacity of inservice teachers and empower teacher preparation programs to improve future teacher readiness (NCATE, 2010). The same is true for SBAE teachers. Shultz et al. (2014) recognized the need to provide a broad spectrum of skill and knowledge development for both inservice and preservice SBAE teachers due to the vast array of duties and expectations associated with the position (Eck, Robinson, Ramsey, & Cole, 2019; Roberts & Dyer, 2004). Terry and Briers (2010) indicated 21 different roles associated with being a SBAE teacher in addition to the three components identified by the National FFA Organization (2015), i.e., classroom/laboratory instruction, FFA, and supervised agricultural experiences (SAE). These various roles help to provide career awareness to secondary students while also preparing them for their future (Wardlow & Osborne, 2010).

“Agricultural education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources systems [AFNR]” (The National Council for Agricultural Education, 2012, para. 3). To help facilitate this mission, national AFNR content standards (The National Council for Agricultural Education, 2015) were developed to provide rigorous curricular focus associated with the eight career clusters. These standards were not only intended for classroom instruction but instead were designed to impact all components of a complete program (The National Council for Agricultural Education, 2015).

SBAE exists, in part, to educate and develop students for careers in the agricultural industry (Roberts & Ball, 2009). Fortunately, SBAE teachers can expose students to various agricultural careers through the FFA (Lundry et al., 2015). In particular, SBAE teachers prepare students in a variety of career development events (CDEs), which allow students to take the learning acquired in the classroom and apply it in a competitive setting (Croom et al., 2009; National FFA Organization, 2019). Therefore, assessing teachers' ability to prepare students in CDEs is an important component worthy of investigation (Terry & Briers, 2010).

CDEs "develop college and career readiness skills" (National FFA Organization, 2019, para. 1) and provide students with an opportunity to apply practical knowledge learned through classroom instruction in challenging, real-world situations (Beekley & Moody, 2002). In addition to content knowledge, critical thinking and problem-solving skills are developed through the preparation and participation in CDEs (Phipps et al., 2008). The development of these additional skills and opportunities presented through CDE participation can ultimately lead to students making better, more informed decisions about their future careers (Talbert & Balschweid, 2006), which can lead to gainful employability (Connors & Mundt, 2001).

For CDEs to be transformative, however, SBAE teachers must be able to provide the necessary training to prepare students for such events. In Oklahoma, the majority of SBAE teachers typically prepare five or fewer teams; although, some prepare as many as 10 teams for the Oklahoma interscholastic event (Lundry Ramsey, Edwards, & Robinson, 2015). Regardless of the number of teams trained, the majority of SBAE teachers prepared teams for CDEs in which they had previous experience (Lundry et al., 2015). Therefore, understanding the degree to which SBAE teachers acquire the knowledge and skills necessary to prepare CDE teams is imperative.

Multiple opportunities exist for SBAE teachers to develop the knowledge and skills necessary to prepare students for CDEs. Traditional teacher preparation programs, which include coursework relative to teaching and learning, content area specific courses, and a student teaching internship (NCATE, 2010), are one way to obtain the expertise necessary to prepare students to compete across a wide variety of CDEs. Traditionally prepared SBAE teachers, who have completed an agricultural education degree through a bachelor's or master's degree program along with student teaching, commonly have the advantage of agricultural content-specific coursework, unlike teachers who are *alternatively* certified (Robinson & Edwards, 2012). However, research suggests teachers who are alternatively certified can be valuable assets to the school, bringing extensive professional experience into the classroom (Ballou, & Podgursky, 1998; Johnson et al., 2005).

Teachers also develop their knowledge and skills by participating in professional development programs. Roberts and Dyer (2004) identified SBAE teachers have an elevated need for professional development in CDEs regardless of certification pathway. Additionally, Clemons et al. (2018) stated, "the need for focused professional development is vital to the continued success of [SBAE] and teacher growth" (p. 87). Ideally, SBAE teachers should be assessed early and often to determine their learning needs and deficiencies (Birkenholz & Harbstreit, 1987). Unfortunately, however, professional development frequently relies on a presenter telling people what they should know or do (Sharma, 2016) instead of identifying the needs of the audience.

The majority of FFA chapters in Oklahoma participate in CDEs (Lundry et al., 2015). The state-level CDE competition is held during the Oklahoma State University (OSU) interscholastic event each Spring semester on the campus of OSU. In 2019, 428 teams participated in 27 different CDEs (Oklahoma Interscholatics, 2019). CDEs range from single-member events to seven-person teams (National FFA Organization, 2019). The number of Oklahoma teams that participated in each event in 2019 are identified in Table 1 in descending order.

Table 1

Participation for the 2019 OSU Interscholastic Career Development Events (N = 428 Teams)

Event	*n*
Livestock Evaluation	62
Land Judging	36
Veterinary science	31
Agricultural Communications	28
Food Science and Technology	27
Agricultural Technology and Mechanical Systems	26
Floriculture	23
Meats Evaluation and Technology	20
Farm and Agribusiness Management	19
Milk Quality and Products	18
Entomology	15
Agronomy	15
Dairy Cattle Evaluation and Management	14
Electricity	14
Horse Evaluation	12
Environmental and Natural Resources	11
Nursery/Landscape	11
Soil and Water Conservation	10
Employment Skills	10
Rangeland Judging	9
Homesite Judging	8
Poultry Evaluation	7
Turfgrass Management	7
Forestry	3
Agricultural Issues Forum	3
Marketing Plan	3
Agricultural Sales	2

CDEs "serve as an outgrowth of instruction in the agricultural education classroom for FFA members in grades 7 to 12" (National FFA Organization, 2019, para. 1) and align with the National Agricultural, Food, and Natural Resources (AFNR) Career Cluster Content Standards (National FFA Organization, 2019). Eight career clusters make up the AFNR Content Standards, i.e., power, structural and technical systems, plant systems, natural resource systems, food products and processing systems, environmental service systems, biotechnology systems, animal systems, and agribusiness systems (The National Council for Agricultural Education, 2015). Ultimately, CDEs are aligned and implemented in SBAE programs to further the agricultural education mission which states, “Agricultural education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources systems” (The National Council for Agricultural Education, 2012, para. 3).

CDEs serve as a vehicle for the development of critical thinking skills and collaboration while furthering students’ interest in AFNR careers (National FFA Organization, 2019). For SBAE to continue to strive to meet its demand (Roberts & Ball, 2009), SBAE teachers must be prepared and ready to rise to the challenge, preparing students for college and careers. Therefore, understanding SBAE teachers' deficiencies related to preparing students for CDEs is a crucial task. This task becomes more daunting, considering the diverse needs of SBAE teachers based on the pathway to certification. In particular, because first-year SBAE teachers have been known as needing the greatest amount of professional development (Layfield & Dobbins, 2002), they served as the target population for this study.

Theoretical/Conceptual Framework

The theoretical framework for this study was based on the concept of teacher self-efficacy (Bandura, 1977). Self-efficacy refers to an individual’s belief associated with achieving a desired goal or task (Bandura, 1997). Bandura (1977) identified four types of experiences impacting self-efficacy, with the greatest predictor being mastery experiences. Therefore, SBAE teachers who have experience in a given CDE might feel more efficacious in preparing students to compete in the same event than those without experience. In this study, first-year SBAE teachers in Oklahoma provided their self-perceived competency as it relates to preparing students for each CDE. Unfortunately, novice teachers have very few, if any, mastery experiences related to making students for a CDE. Therefore, they commonly rely on vicarious experiences (Bandura, 1977), which are the second greatest predictor of self-efficacy and refer to the observation of a specific skill or behavior (Bandura, 1977). Influenced by the work of Bandura (1977), teacher self-efficacy refers to an individuals’ ability to engage students in the learning environment and improve their learning outcomes (Tschannen-Moran et al., 1998). Students who learn from teachers high in teacher self-efficacy have been shown to outperform those who learn from teachers lower in teacher self-efficacy (Henson, 2001). Teacher self-efficacy is linked to increased teacher performance and career sustainability (Tschannen-Moran et al., 1998), leading to the importance of this line of inquiry with first-year SBAE teachers, as recruitment and retention continue to be a challenge (Eck & Edwards, 2019).

Purpose of the Study

The purpose of this study was to identify the CDEs in greatest need of professional development according to first-year SBAE teachers in Oklahoma. Four research objectives guided the study:

1. Describe the personal and professional characteristics (i.e., sex, gender, pathway to certification, highest degree earned, size of program and past CDE experience) of first-year SBAE teachers in Oklahoma,
2. Identify first-year SBAE teacher's competency for each of the Oklahoma CDEs,
3. Identify SBAE teachers' interest to prepare teams for each of the CDEs, and
4. Prioritize the CDEs, according to first-year SBAE teachers, in need of professional development using the Borich needs assessment model.

Methods and Procedures

The population of interest for this descriptive pilot study was first-year SBAE teachers in Oklahoma ($N = 40$) during the 2019 to 2020 school year. A time and place sampling method (Oliver & Hinkle, 1982) was employed during a required new teacher training workshop for SBAE teachers, hosted by Oklahoma Career and Technical Education staff. All ($N = 40$) first-year SBAE teachers in Oklahoma were required to attend the workshop. Of the 40 first-year SBAE teachers in Oklahoma, 39 were present, and 37 completed the instrument by successfully responding to all questions, resulting in a 92.5% response rate. The instrument was designed to assess SBAE teachers' competency and interest of the 27 CDEs in Oklahoma following the Borich Needs Assessment Model (Borich, 1980). "The needs assessment model is essentially a self-evaluative procedure which relies on teachers' judgements about their own performances" (Borich, 1980, p. 42). The model allows researchers to determine if a discrepancy exists between the two poles indicated in the instrument (Borich, 1980). This study sought to determine the discrepancy between teachers' self-perceived interest and competency to train students in various CDEs. The resulting score will be used to identify professional development opportunities for first-year SBAE teachers in Oklahoma, as discrepancy scores with the greatest positive rank identify the highest priority for professional development (Borich, 1980). The model was utilized to measure the teachers' interest and competence in preparing students for CDEs and preparing them for careers. To determine where deficiencies existed, Borich's (1980) mean weighted discrepancy scores (MWDS) was employed. Specifically, the mean weighted competence rating was subtracted from the mean weighted importance rating to determine a discrepancy score. Then, every discrepancy score was multiplied by the mean importance rating to produce a weighted discrepancy score. Finally, the weighted discrepancy scores were totaled and divided by the number of respondents ($n = 37$) to produce a mean weighted discrepancy score (MWDS). Finally, all MWDS of each item was ranked from high to low to determine the CDEs in greatest need of professional development.

Although Oklahoma FFA conducts 29 state CDEs, only 27 were chosen for this study. The two CDEs omitted (Agricultural Education and the Freshman Agriscience Quiz Bowl) were excluded from the study due to not containing specific content knowledge related to agricultural, food, and natural resource (AFNR) standards. The 27 CDEs included in the instrument were: Agricultural Communications, Agricultural Issues Forum, Agricultural Technology and Mechanical Systems, Agricultural Sales, Agronomy, Dairy Cattle Evaluation and Management, Electricity, Employment Skills, Entomology, Environmental and Natural Resources, Farm and Agribusiness Management, Floriculture, Food Science and Technology, Forestry, Homesite Judging, Horse Evaluation, Land Judging, Livestock Evaluation, Marketing Plan, Meats Evaluation and Technology, Milk Quality and Products, Nursery/Landscape, Poultry Evaluation, Soil and Water Conservation, Rangeland Judging, Turfgrass Management, and Veterinary Science. In addition to the 27 competency and interest assessments of CDEs, participants were asked to identify their intent to prepare teams for each of the 27 CDEs, along with six demographic questions aimed to describe the participants (i.e., sex, age, pathway to certification, highest degree earned, program size, and past experiences related to CDEs). Ultimately, the population of interest for this instrument includes all SBAE teachers; therefore, the sample of first-year SBAE teachers served as an appropriate pilot group.

The instrument was developed in Qualtrics and distributed electronically to first-year SBAE teachers during their new teacher inservice at the state career and technical education office in [City] on August [add date]. Before delivery of the instrument, the research team, consisting of two faculty members and one graduate student in the [Department], evaluated the instrument for face and content validity. The team has more than 50 years of experience teaching agricultural education at the secondary (which included preparing students participating in CDEs) and higher education levels, and each helps prepare students to teach in SBAE programs. Also, all team members have conducted numerous quantitative studies, and two of the team members have used the Borich (1980) model extensively in previous research, qualifying the team as able to assess the face and content validity of the instrument. After review, the instrument was deemed acceptable for the pilot stage of this study.

The instrument complexity, length, and mobile device compatibility were assessed based on the recommendations of Dillman, Smyth, and Christian (2014). The purpose of the study was explained to the participating teachers before they were provided informed consent forms, a QR code, and a weblink to participate on their devices.

After data collection was completed, data were transferred from Qualtrics to the Statistical Program for Social Sciences (SPSS), Version 23, and Microsoft Excel for analysis. Personal and professional characteristics were analyzed in SPSS using descriptive statistics to explain the composition of first-year SBAE teachers in Oklahoma. Mean scores were calculated for interest and competence on each of the 27 CDEs to determine the overall rating from participants. Interest was measured on a four-point scale, where 1 = extremely uninterested, 2 = somewhat uninterested, 3 = somewhat interested, and 4 = extremely interested. Similarly, competence was measured on a four-point scale, where 1 = extremely incompetent, 2 = somewhat incompetent, 3 = somewhat competent, and 4 = extremely competent. For the MWDS analysis, the Excel MWDS calculator developed by McKim and Saucier (2011) was used to determine the professional development needs of first-year SBAE teachers in Oklahoma.

Findings

The first research objective sought to describe the personal and professional characteristics of first-year SBAE teachers in Oklahoma. Table 2 displays those characteristics including sex, age, pathway to certification, highest degree earned, program size, and past experiences related to CDEs. First-year SBAE teachers for the 2019 to 2020 school year in Oklahoma ranged in age from 21 to 61 years old, with just over one-half being female (51.4%). Over one-third (f = 14, 37%) entered the profession through a non-traditional certification route; however, 62.2% (f = 23) were traditionally certified, indicating they had completed an agricultural education bachelor's or master's degree program. Nearly 92% (*f* = 34) of the participants had previous experience (i.e., competed as a student in 4H or FFA, prepared a team, participated in professional development, or completed coursework) related to livestock evaluation. More than one-half (*f* = 19, 51%) had experiences in agricultural communications (see Table 2).

Table 2

Personal and Professional Characteristics of First-Year SBAE Teachers in Oklahoma (n = 37)

Characteristic		*f*	%
Sex	Male	17	45.9
	Female	19	51.4
	Did not respond	1	2.7
Age	21 to 25	18	48.6
	26 to 30	3	8.1
	31 to 35	5	13.5
	36 to 40	3	8.1
	41 to 50	5	13.5
	51 to 60	1	2.7
	60 +	1	2.7
	Did not respond	1	2.7
Certification Pathway	AgEd BS	19	51.4
	AgEd MS	4	10.8
	Alternatively Certified	9	24.3
	Emergency Certified	4	10.8
	Not Certified	1	2.7
Highest Degree Earned	Bachelor's Degree	28	75.7
	Master's Degree	9	24.3
	Doctoral Degree	0	0.0
Program Size (# of students)	1 to 20	0	0.0
	21 to 40	8	21.6
	41 to 60	11	29.7
	61 to 80	2	5.4
	81 to 100	7	18.9
	100 to 150	3	8.1
	151 to 200	1	2.7
	201 to 250	2	5.4
	Unknown	1	2.7
	Did not respond	2	5.4
Past CDE Experience	Livestock Evaluation	34	91.9
	Agricultural Communications	19	51.4

Agricultural Sales	16	43.2
Agricultural Technology and Mechanical Systems	14	37.8
Land Judging	13	35.1
Meats Evaluation and Technology	12	32.4
Veterinary Science	12	32.4
Horse Evaluation	11	29.7
Dairy Cattle Evaluation and Management	10	27.0
Floriculture	10	27.0
Food Science and Technology	10	27.0
Milk Quality and Products	10	27.0
Electricity	9	24.3
Employment Skills	9	24.3
Agricultural Issues Forum	8	21.6
Farm and Agribusiness Management	8	21.6
Entomology	7	18.9
Environmental and Natural Resources	7	18.9
Poultry Evaluation	7	18.9
Soil and Water Conservation	7	18.9
Forestry	5	13.5
Marketing Plan	5	13.5
Nursery/Landscape	5	13.5
Rangeland Judging	5	13.5
Agronomy	3	8.1
Homesite Judging	2	5.4
Turfgrass Management	2	5.4

Additionally, first-year SBAE teachers in Oklahoma were asked to identify their intent to prepare a team for each of the 27 CDEs during the 2019 to 2020 school year. These intentions are displayed in Table 3 in order of the highest intended participation. Livestock Evaluation (f = 28), Agricultural Communications (f = 19), Veterinary Science (n = 15), Land Judging (f = 13), and Agricultural Technology and Mechanical Systems (f = 10) were the top five CDEs for which first-year teachers intended to train. None of the teachers intended to prepare a Homesite Evaluation or Soil and Water Conservation team (see Table 3).

Table 3

First Year Oklahoma SBAE Teachers Intent to Prepare CDE Teams (n = 37)

CDE	*f*	%
Livestock Evaluation	28	75.7
Agricultural Communications	19	51.4
Veterinary Science	15	40.5
Land Judging	13	35.1
Agricultural Technology and Mechanical Systems	10	27.0
Floriculture	9	24.3

Food Science and Technology	9	24.3
Meats Evaluation and Technology	9	24.3
Agricultural Issues Forum	7	18.9
Agricultural Sales	7	18.9
Environmental and Natural Resources	7	18.9
Employment Skills	6	16.2
Poultry Evaluation	6	16.2
Rangeland Judging	6	16.2
Agronomy	5	13.5
Dairy Cattle Evaluation and Management	5	13.5
Farm and Agribusiness Management	5	13.5
Horse Evaluation	5	13.5
Milk Quality and Products	5	13.5
Marketing Plan	4	10.8
Nursery/Landscape	4	10.8
Electricity	3	8.1
Turfgrass Management	3	8.1
Entomology	2	5.4
Forestry	2	5.4
Homesite Judging	0	0.0
Soil and Water Conservation	0	0.0

The second and third research questions sought to determine the interest and competency levels of first-year SBAE teachers in Oklahoma on a four-point scale of agreement. Livestock Evaluation resulted in the highest mean score for both CDE interest and competency of first-year SBAE teachers, and the Homesite CDE received the lowest mean scores in both areas (see Table 4). Participants deemed they were somewhat interested in Livestock Evaluation and Agricultural Communications, as evidenced by a mean score of 3.0 or greater. The remaining 25 CDEs were in the somewhat uninterested range. Regarding their competence, first-year SBAE teachers perceived themselves to be somewhat to extremely incompetent in all CDE areas except for livestock evaluation (M = 3.07, SD = .79), where they deemed themselves somewhat competent.

The fourth research question sought to prioritize the CDEs, as perceived by first-year teachers, in need of professional development using the Borich (1980) needs assessment model. Livestock Evaluation (MWDS = 3.73) was the CDE possessing the greatest need for professional development (see Table 4). Three other CDEs had an MWDS exceeding 3.0, including Veterinary Science (MWDS = 3.62), Meats Evaluation and Technology (MWDS = 3.34), and Food Science and Technology (MWDS = 3.16). In contrast, two CDEs, Dairy Cattle Evaluation and Management (MWDS = .98) and Electricity (MWDS = .96), had MWDS scores less than 1.0.

Table 4

CDE interest, Competency, and Mean Weighted Discrepancy Scores of First-Year SBAE Teachers in Oklahoma (n = 37)

CDE	Interest[a]		Competency[b]		MWDS[c]
	M	*SD*	*M*	*SD*	
Livestock Evaluation	3.54	.61	3.07	.79	3.73
Veterinary Science	2.97	1.04	2.17	.91	3.62
Meats Evaluation and Technology	2.81	.78	2.07	.96	3.34
Food Science and Technology	2.82	.93	2.03	.85	3.16
Agricultural Sales	2.84	.93	2.34	.97	2.84
Farm and Agribusiness Management	2.73	.96	2.20	1.03	2.58
Employment Skills	2.92	.97	2.59	.91	2.50
Agricultural Issues Forum	2.62	1.06	2.07	.98	2.48
Agricultural Communications	3.03	.83	2.83	.83	2.21
Environmental and Natural Resources	2.46	1.04	1.93	.91	2.19
Milk Quality and Products	2.68	.92	2.30	.88	2.17
Marketing Plan	2.57	.87	2.13	.94	2.15
Land Judging	2.46	.96	2.03	.85	1.99
Agricultural Technology and Mechanical Systems	2.53	1.06	2.17	.95	1.83
Floriculture	2.51	.99	2.20	1.10	1.83
Rangeland Judging	2.14	1.11	1.63	.93	1.73
Turfgrass Management	2.14	.98	1.67	.92	1.67
Soil and Water Conservation	2.19	1.05	1.77	1.01	1.66
Agronomy	2.19	.95	1.86	.85	1.65
Forestry	2.24	1.04	1.87	.90	1.64
Poultry Evaluation	2.16	1.07	1.73	.83	1.64
Horse Evaluation	2.33	1.12	1.97	1.22	1.62
Entomology	2.25	1.05	1.90	1.03	1.50
Nursery/Landscape	2.19	1.02	1.90	.96	1.42
Homesite Judging	1.78	.95	1.52	.79	1.06
Dairy Cattle Evaluation and Management	2.27	.99	2.27	1.08	.98
Electricity	2.08	.92	2.00	.95	.96

Note. [a]Interest items were on a 4-point scale of agreement, where 1 = Extremely uninterested, 2 = Somewhat uninterested, 3 = Somewhat interested, 4 = Extremely interested. [b]Competency items were on a 4-point scale of agreement, where 1 = Extremely incompetent, 2 = Somewhat incompetent, 3 = Somewhat competent, 4 = Extremely competent. [c]MWDS = Mean Weighted Discrepancy Score.

Conclusions

This study sought to identify the professional development needs of first-year SBAE teachers in Oklahoma, based on their interest and competence as it relates to preparing students for CDEs. The findings of this study resulted in multiple conclusions. Based on the positive MWDS, first-year SBAE teachers in Oklahoma deem all 27 CDEs to be of value; although, they were not necessarily interested in preparing student teams for all the CDEs. As the majority of SBAE teachers in Oklahoma typically prepare five or fewer teams (Lundry et al., 2015), teachers not having an interest in preparing students for all CDEs is realistic.

First-year teachers' interest in CDEs exceeds their self-perceived competence to prepare students for them. Except for Dairy Cattle Evaluation and Management, which had the same ratings ($M = 2.27$) for interest and competence, first-year teachers rated 26 of the 27 CDEs higher on the interest scale than on the competence scale. This finding is consistent with previous research using Borich's (1980) needs assessment model (Radhakrishna & Bruening, 1994; Robinson et al., 2007).

The CDEs with the greatest MWDS are the highest priority (Borich, 1980) for first-year SBAE teachers in Oklahoma, including Livestock Evaluation, Veterinary Science, Meats Evaluation and Technology, Food Science and Technology, and Agricultural Sales. Regarding the teachers' past CDE experiences, these five were some of the highest regarding their participation. Specifically, 92% of these teachers had participated in the Livestock Evaluation CDE, giving support to teachers' perceived mastery and vicarious experiences (Bandura, 1977; Tschannen-Moran et al., 1998). Such experiences play a significant role in motivating teachers to continue learning about these content areas and preparing students to participate in them. Ultimately, these five CDEs should be given the highest priority for future professional development offerings for SBAE teachers in Oklahoma.

Professional development related to CDEs in Oklahoma based on the findings of this study provides SBAE teachers an opportunity to increase their self-efficacy through mastery and vicarious experiences (Bandura, 1977). This investment in additional purposeful professional development aims to improve the individual's teacher self-efficacy for performing tasks related to and within these CDEs. Additionally, CDE participation is intended to align with AFNR Career Cluster Content Standards being taught within the SBAE program (The National Council for Agricultural Education, 2015); therefore, the increased self-efficacy serves the teacher in multiple capacities. Teachers have the opportunity to enhance their ability to prepare students for CDEs and careers while also providing students an opportunity to acquire over 20 additional workplace skills through CDE participation (Lundry et al., 2015).

Recommendations

Agricultural education faculty at OSU should look for ways to incorporate the top five CDEs (i.e., Livestock Evaluation, Veterinary Science, Meats Evaluation and Technology, Food Science and Technology, and Agricultural Sales) into the existing curriculum and plan of study. In particular, the findings should be shared with faculty who teach courses in these areas, and attempts should be made to highlight these CDEs in classes with students whenever possible. Also, students should be encouraged to volunteer for the Oklahoma FFA Interscholastic Event held at Oklahoma University each Spring by participating in a CDE area in which they lack competence and experience.

The findings of this study should also be shared with Career and Technical Education supervisors and other interested personnel who provide professional development to first-year SBAE teachers. Specifically, those delivering professional development sessions should be encouraged to focus first on the content areas involving Livestock Evaluation, Veterinary Science, and Meat Evaluation and Technology; these CDEs had the highest MWDS and therefore demand the greatest attention related to professional development in Oklahoma. Further, additional professional development for first-year teachers in Oklahoma should be considered for the remaining CDEs with elevated MWDS once the top five have been satisfied. Additions to pre-service agricultural education teacher preparation coursework focused on commonly identified CDE needs of SBAE teachers would help to further the self-efficacy of pre-service teachers as they prepare to enter the profession. These professional development opportunities could occur as ongoing workshops facilitated by content experts (i.e., university faculty or in-service SBAE teachers).

Considering recommendations for research, this study should be replicated for all SBAE teachers in Oklahoma ($N = 454$) (Oklahoma Career Tech, 2019), as the use of first-year SBAE teachers was intended as a pilot group for the instrument. Agricultural education faculty in other states should consider replicating this study to determine the professional development needs of their SBAE teachers related to CDEs. Replication of this study should be conducted with pre-service teachers to determine their CDE deficiencies. Understanding these gaps might allow teacher educators to advise students differently regarding their plans of study or include pertinent content related to CDEs in their existing courses and agricultural education teacher preparation programs.

Discussion

The needs of SBAE teachers are diverse when considering career tenure and pathway to certification. Therefore, the demand to increase the development of teacher self-efficacy is pertinent (Eck et al., 2019; Roberts & Dyer, 2004; Shultz et al., 2014). Identifying and meeting the needs of SBAE teachers must be ongoing and sustained over time. Although Livestock Evaluation was identified as the CDE in which respondents had the most previous experience, it was still considered as the highest priority for first-year SBAE teachers in Oklahoma. Additionally, Livestock Evaluation had the greatest number of teams participate in a given year at the Oklahoma State FFA CDE Interscholastic (see Table 1) (Oklahoma Interscholatics, 2019). Furthering the understanding of first-year SBAE teachers in Oklahoma provides stakeholders an opportunity to meet the imperative task of preparing them to meet the demand highlighted by Roberts and Ball (2009) who advocated for developing students for positions within the agricultural industry, with AFNR career exploration through CDEs at the state and national levels (National FFA Organization, 2019). The development of purposeful professional development will allow SBAE teachers an opportunity to increase their self-efficacy (Bandura, 1977), as their participation in such programs serves as an investment in their education, leading to improved competence in preparing students for CDEs.

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Reconceptualizing Problem-Solving: Applications for the Delivery of Agricultural Education's Comprehensive, Three-Circle Model in the 21st Century

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Reconceptualizing Problem-Solving: Applications for the Delivery of Agricultural Education's Comprehensive, Three-Circle Model in the 21st Century

Abstract

Problem-solving has been an integral tenet of school-based, agricultural education (SBAE) since its inception. However, in many ways, the pedagogy has changed considerably. This shift appears to have caused problem-solving's pedagogical dimensions and underlying philosophical foundation to become conflated with other methods of instruction. Consequently, fundamental questions persist: "Should problem-solving be practiced as a distinct pedagogy?" And if so, "What implications exist for its use in SBAE?" In response, this philosophical study sought to examine perspectives on problem-solving and explain how it has been advanced in the discipline. A product of this investigation was the emergence of three principles that appear to be foundational to problem-solving: (1) identify problems, (2) analyze information, and (3) evaluate solutions. Distinguishing such principles helped describe how problem-solving has been operationalized historically. However, it also revealed a need to expand its current understanding and use. In response, we proposed the Integrated Problem-Solving Model for Agricultural Education to illuminate how it could be reconceptualized as a guiding philosophy for SBAE to better navigate increasingly complex issues and problems in the 21st Century.

Introduction

Over the past few decades, a variety of instructional methods have been advanced in education to encourage students to obtain the skills they need to thrive in the 21st Century (Koichu, 2019; Ulmer & Torres, 2007). However, more recently, it has become critical for educators to adopt methods of instruction that encourage students to develop higher-order thinking skills (Fuhrmann & Grasha, 1983; Jonassen, 2000; Ulmer & Torres, 2007). One explanation for this shift is that employers often view the ability to solve problems, a higher-order skill, as essential in the workplace (Gokhale, 1995; Robles, 2012; Zimmerman & Risemberg, 1997). Nevertheless, many students are not challenged to engage in real-world problems in their schooling (Jonassen, 2000). Instead, they learn through rote memorization and other forms of direct instruction in which the instructor passively transfers knowledge – an approach that does little to prepare students for a successful career (Jonassen, 2000). As a consequence, a need has emerged to embed more opportunities for students to authentically engage in problem-based experiences that accurately reflect the world in which they operate. Previous research has demonstrated that engaging students in learning activities that challenge their problem-solving abilities can foster metacognitive growth, i.e., the ability to reflect on learning and modify one's behavior accordingly (Sproull, 2001). For example, through the use of such an approach, students learn to grapple with problems, from simple to complex, by developing solutions that complement the knowledge and skills they developed through their coursework (Jonassen, 2000).

From a historical perspective, the problem-solving approach can be traced to classical philosophers such as Socrates and Plato, who believed that individuals came to truth by socially constructing meaning through participation in debates (Phillips, 2010). For example, *The Socratic Method* draws on cooperative dialogue in which individuals answer questions that stir new thoughts and ideas about the nature of knowledge and knowing (Phillips, 2010). This early approach to problem-solving appeared to serve as a basis for contemporary views on the method and helped further distinguish it as a pedagogy (Dewey, 1910; Phillips, 2010). Using this foundation, John Dewey (1910) further concretized the key dimensions of problem-solving. For instance, in Dewey's (1910) *How We Think,* he outlined five tenets called the *Complete Action of Thought or Reflective Thinking* that included: (1) a felt difficulty; (2) location and definition of a problem; (3) creation of possible solutions; (4) test solutions; and (5) further explorations and evaluation. These processes provided a basis for conceptualizing problem-solving as a process that could be used to mature students' intellectual development and critical thinking (Dewey, 1910). However, Dewey never used the term *problem-solving* in his academic work.

Despite this, Dewey, along with other educational philosophers, paved the way for problem-solving to be recognized and practiced as a pedagogy in the 20th Century (Moore & Moore, 1984). However, discourse on problem-solving has been muddled by the introduction of terms, such as problem-based learning (PBL) and inquiry-based instruction (IBI), that although are distinct in form and function also appear to exhibit striking "pedagogical congruence" (Parr & Edwards, 2004, p. 104). As a result, a definition for problem-solving does not appear to have reached consensus. Some disciplines have responded to this issue by crafting descriptions of the pedagogy that integrate the various perspectives of philosophers, researchers, and practitioners (Crunkilton & Krebs, 1967; Jonassen, 2000; Merwin, 1977). The definition of problem-solving, therefore, varies considerably among academic disciplines. For example, in technology education, Merwin (1977) defined problem-solving as "a sequence of procedures in the thinking process that a learner employs in dealing with a problem or task" (p. 123). Jonassen (2000) added that problem-solving could also allow students to "find [answers to] the unknown." (p. 65). In agricultural education, however, Crunkilton and Krebs (1967) defined problem-solving "as a method of teaching in which the teacher guides the class through a series of questions. . ." (p. 90). Because of such variant depictions, therefore, problem-solving's philosophical and operational tenets remain unclear.

Nevertheless, the pedagogy appears to have been considered an integral tenet of school-based, agricultural education (SBAE). For example, the use of the pedagogy emerged in SBAE in concert with the Smith-Hughes Act of 1917 (Moore & Moore, 1984). During this period, the U.S. experienced an industrial revolution, which shifted education and catalyzed reform efforts (Roberts, 1957; Roberts & Ball, 2009; Talbert et al., 2007). This shift also piqued national interest in the enhancement of skilled laborers (Roberts & Ball, 2009). Because of these changes in U.S. society, it is believed that problem-solving became diffused as a method of instruction in SBAE (Moore & Moore, 1984) and experienced more widespread adoption (Boone, 1990; Cano & Martinez, 1991; Crunkilton & Krebs, 1967; Dyer & Osborne, 1996; Flowers & Osborne, 1988; Hammonds, 1950; Krebs, 1967; Newcomb et al., 1993; Phipps & Osborne, 1988; Torres & Cano, 1995a; Torres & Cano, 1995b). However, problem-solving has been described, represented, and depicted in a variety of ways throughout its rich history in SBAE. Such variances were made explicitly clear in submissions that described problem-solving in *The Agricultural Education Magazine* (*The Magazine*).

For example, as evinced in *The Magazine*, problem-solving's use in SBAE emerged in the mid 20th Century (Hammonds, 1950; Krebs, 1967). However, in many ways, the pedagogy, and other methods of instruction, have evolved considerably in the early 21st Century as practitioners responded to key shifts in American society (Roberts & Edwards, 2015, 2018). In particular, in the early 2000s, the enactment of *No Child Left Behind* (NCLB) created a turning point in U.S. education policy that resulted in wide-sweeping reform efforts, which required states to adopt learning standards and assessments to monitor better and track students' progress, especially regarding mathematics, reading, and science (U.S. Department of Education, 2001). Such changes also largely influenced approaches to teaching and learning that were depicted in *The Magazine*. For instance, contributors published articles on learning approaches that featured: (a) PBL, (b) IBI, and (c) experiential learning that focused on applications of science, technology, engineering, and mathematics (STEM) (Retallick & Miller, 2005; Torres & Cano, 2005a).

Although such work was pivotal to positioning SBAE as relevant, during this period, problem-solving's pedagogical dimensions and underlying philosophical foundation also appeared to become blurred and conflated with other teaching and learning approaches. As a consequence, a dichotomy emerged in which some practitioners began to represent problem-solving as a distinct method of instruction, while others articulated it as an approach that was largely synonymous with other pedagogies (Parr & Edwards, 2004). Because of these discrepancies in the problem-solving literature, a lack of clarity exists in SBAE regarding how problem-solving should be delivered conceptually. To complicate this issue further, however, early literature in SBAE (Crunkilton & Krebs, 1967; Moore & Moore, 1984) on problem-solving argued it lacked a solid theoretical foundation and should be approached with caution when used as a method of instruction. As a consequence, two questions persist: *"Should problem-solving be practiced as a distinct pedagogical approach?* And if so, *"What implications exist for using problem-solving in the 21st Century and beyond?"* These questions motivated the current study.

Purpose

To address this issue**,** the purpose of this philosophical investigation was threefold: (1) describe existing perspectives and theories on problem-solving; (2) explain how problem-solving has been used as a method of instruction in SBAE; and (3) illuminate how the problem-solving could be reconceptualized to enrich the delivery of SBAE's comprehensive, three-circle model. This research aligns with the American Association for Agricultural Education's National Research Agenda Research Priority 7: *Addressing Complex Problems.* Specifically, this research addresses question one, "What methods, models, and programs are effective in preparing people to solve complex problems, interdisciplinary problems?" (Andenoro, Baker, Stedman, & Pennington, Weeks, 2016, p. 59).

Methods and Procedures

Philosophical research seeks to analyze existing axioms and beliefs in a given domain (Roberts & Edwards, 2020; Salevouris & Furay, 2015). This study, therefore, synthesized educational theories and perspectives from prominent problem-solving advocates, while also advancing new understandings for SBAE. From a philosophical perspective, problem-solving aligns with the worldview of pragmatism, which advances the belief that individuals construct meaning from their experiences as they interact with others and navigate issues and problems in a real-world context (Crotty, 1998). To meet the study's purpose, we synthesized theoretical and practitioner-oriented work as well as empirical evidence supporting problem-solving through the use of the following sources: (a) books, (b) peer-reviewed journal articles, and (c) *The Agricultural Education Magazine*.

All references were subjected to internal and external criticisms to triangulate our findings (Salevouris & Furay, 2015). For instance, we evaluated each source for authenticity concerning its origin and content (Salevouris & Furay, 2015). Further, we analyzed how the investigation's (a) findings, (b) conclusions, (c) implications, and (d) recommendations might provide inferences for future work. To accomplish this, we used a conceptual mapping technique in which we scrutinized each source's existing similarities and discrepancies (Salevouris & Furay, 2015). For example, through mapping, we revealed each source's interconnectedness and congruence with the study's purpose (Salevouris & Furay, 2015). As a result, we developed key empirical assertions through the use of an analytic memoing technique (Saldaña, 2015). Then, we synthesized our findings by weaving our assertions into a narrative that described how problem-solving could be reimagined to deliver agricultural education's comprehensive, three-circle model in transformative new ways.

Perspectives and Theories on Problem-Solving

Through our analysis, six leading perspectives – John Dewey, Rufus Stimson, Werrett Charters, William Lancelot, John Bransford, and Scott Johnson – on problem-solving appeared to most prominently shape existing thought and use of the pedagogy in SBAE as well as in teaching and learning more broadly. Our description of each perspective is provided next.

John Dewey

John Dewey largely gained prominence as a thought leader as a result of his time at the University of Chicago after creating a progressive school, called the *Dewey Laboratory School,* that he used to foment his philosophy and theory on experience and education (Dewey, 1910, 1938). Dewey believed that students should be viewed as active pursuers of knowledge that lived, worked, and interacted in the world as a social being (Hyland, 1993). Dewey was also a strong advocate for students actively engaging in experiences that were based on real-world issues and problems (Dewey, 1938). In particular, Dewey maintained that teaching students to think and solve problems was integral to creating successful members of society (Dewey, 1910). Further, Dewey (1910) detailed in *How We Think* his five-step model for *reflective thinking.* Dewey's five axioms for reflective thinking included: (a) felt difficulty, (b) location and definition of the problem, (c) creation of solutions, (d) development of reasons for solutions, and (e) further exploration and evaluation (Dewey, 1910).

Rufus Stimson

Rufus Stimson has also been identified as a pivotal early leader to agricultural education in the U.S. (Moore, 1988, 2018). Perhaps, his most significant contribution to the discipline was the formalization of the project-based method, which is now recognized as the Supervised Agricultural Experience (SAE) component of agricultural education's comprehensive, three-circle model (Camp & Crunkilton, 1985; Foor & Connors, 2010; Moore, 1988). Although Stimson (1911, 1919) did not use the term *problem-solving*, many of the core features of the project-based method, align naturally with the pedagogy. For example, Stimson (1911) advanced three major projects relevant for farm work: (1) improvement, (2) experimental, and (3) productive. In his description of project types, Stimson (1919) explained that each would require students to identify relevant problems, collect evidence, and design a strategy to respond to each unique issue or problem. Such work also deeply influenced his protégé Werrett Charters.

Werrett W. Charters

Werrett Charters was a student of Dewey for three years at the University of Chicago. It is because of this experience that Charters is often recognized as a disciple of Dewey and a proponent of his philosophy and beliefs on teaching and learning. However, he also made pivotal advancements to problem-solving in his own right. For instance, in Charters' works *Methods of Teaching and Teaching* (1912) and *Teaching the Common Branches* (1924) he emphasized the importance of having students solve real-world problems that piqued their interest and motivated them to be actively engaged in the learning process (Charters, 1912, 1924). Similar to Dewey's (1910) reflective thinking model, Charters advanced both inductive and deductive reasoning (Charters, 1924). However, Charters also theorized that inductive thinking processes could help propel students' deductive thinking as they work through contextualized problems, form hypotheses, and arrive at concrete solutions (Charters, 1912). As a result, Charters (1924) advanced three stages of problem-solving: (a) definition of the problem, (b) creation of a hypothesis, and (c) testing and verifying the solution. Such advancements appear to have profoundly influenced how problem-solving was operationalized in its formative years in SBAE.

William Lancelot

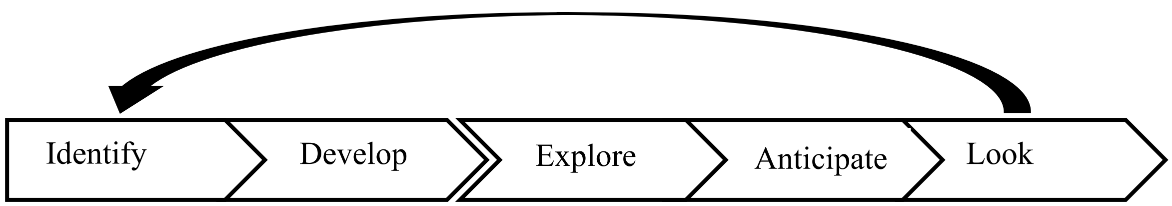
William Lancelot was another early proponent of problem-solving in SBAE. Lancelot received his bachelor's degree in agricultural education in 1919 and shortly after pursued his master's degree in education at Columbia University. During his graduate studies, Lancelot was introduced to the works of Dewey and Charters, which greatly influenced by his views on education and society (Lancelot, 1944). As a result, Lancelot advocated for transitioning education from a rote memorization model to one that closely mirrors problem-solving (Lancelot, 1944). In his book *Permanent Learning* (1944), he described different types of problems that students may encounter during their educational experiences, how to use such problems productively, ways to integrate problems across contexts, and the uses of the problem-solving in regard to teaching and learning. Further, Lancelot (1944) conceptualized 10 steps that educators could use to implement problem-solving as a pedagogy. Similar to Dewey and Charters, Lancelot also articulated the role of inductive and deductive reasoning. Because of his deep connection to SBAE, his work appeared to influence the discipline profoundly. However, in the proceeding decades, other prominent educational leaders influenced SBAE as well.

John D. Bransford

John Bransford was an educational psychologist at the University of Washington who authored several critical works regarding cognition, learning styles, and teaching. For example, in Bransford's and Stein's (1984) *The IDEAL Problem Solver,* he introduced an approach to problem-solving that encompassed the ideas and theories of several key theorists such as Kolb (1984), Newell and Simon (1972), and Sterberg (1981). The IDEAL problem-solving model also drew on concepts from the Socratic method, the scientific method, and John Dewey's reflective thinking model (Phipps, Osborne, Dyer, & Ball, 2008). In particular, the IDEAL problem-solving model largely reconceptualized Dewey's reflective thinking model using the following processes: (a) identify problems and opportunities, (b) develop goals, (c) explore possible strategies, (d) anticipate outcomes, and (e) look back. It is critical to note that in the IDEAL problem-solving model, each step is fluid and may not unfold successively (Bransford & Stein, 1984). Figure 1 depicts Bransford's and Stein's (1984) IDEAL problem-solving model.

Figure 1

Bransford's and Stein's (1984) IDEAL Problem-Solving Model



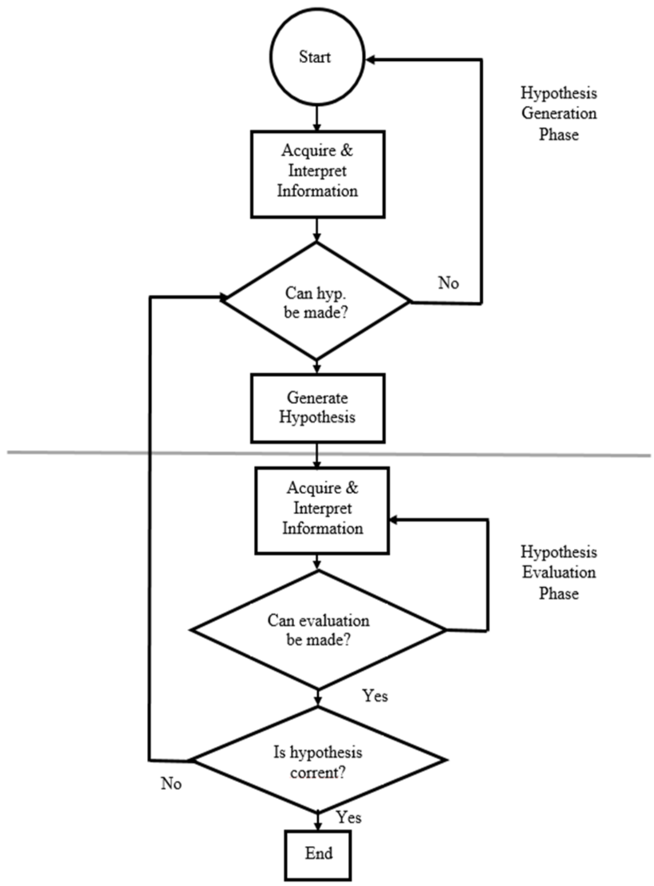
Note. Adapted from "The Influence of Cognitive Diversity on Group Problem-solving Strategy" by A. J. Lamm, C. W. Shoulders, G. T. Roberts, T. A. Irani, L. J. Snyder, and J. Brendemuhl, 2012, *Journal of Agricultural Education, 53*(1), p. 19. Copyright 2012 by *Journal of Agricultural Education*. Reprinted with permission.

Scott Johnson

Another vein of literature that has greatly influenced problem-solving theory and practice is troubleshooting. And, perhaps, the individual that has most profoundly advanced thought on troubleshooting is Scott Johnson. For example, Johnson's (1989) technical troubleshooting model provided conceptual guidance for practitioners to support students as they navigate complex curricular problems. In the first phase of the model, students collect and interpret information through two primary sources: (1) procedural knowledge, and (2) external sources (Johnson, 1991). Procedural knowledge refers to an individual's understandings that result from processes such as reading diagrams, using mathematical formulas, and understanding manuals (Johnson, 1989). Meanwhile, external sources of information typically originate from the knowledge that individuals glean from jobs, technical support, and evaluations (Johnson, 1989). Of note, both sources of knowledge help troubleshooters form a more concrete understanding of the problem (Johnson, 1991). Based on Johnson's (1989) model, after individuals acquire information from the aforementioned sources, they enter an interpretation phase (Johnson, 1991). This step is critical because troubleshooters must identify which concepts are relevant based on their prior learning and experiences (Johnson, 1989). If enough information has been gathered, then the troubleshooter can then move into the hypothesis generation phase. During this step, individuals generate one or more hypotheses about the problem (Elstein et al., 1978; Frederiksen, 1984; Johnson, 1989). After the hypothesis generation phase, troubleshooters evaluate their results, which allows the troubleshooter to test their hypotheses and determine whether it should be accepted or rejected (Johnson, 1991). If the troubleshooter did not solve the problem, they restart the process, as depicted in Figure 2 (Johnson, 1991).

Figure 2

Troubleshooting Model



Note. Adapted from "A description of expert and novice performance differences on technical troubleshooting tasks" by S.D. Johnson, 1989, *Journal of Industrial Teacher Education*, *26*(3), p. 20. Copyright 1989 by *Journal of Industrial Teacher Education*. Reprinted with permission.

Problem-Solving's Use in SBAE

In addition to being articulated by leading educational theorist, problem-solving has also been advanced in SBAE since its early inception as a way to facilitate authentic learning for students (Moore & Moore, 1984; Parr & Edwards, 2004; Retallick & Miller, 2005; Torres & Cano, 2005b). As an illustration, Phipps and Cook (1956) advanced Dewey's (1910) stages of problem-solving by contextualizing the pedagogy using examples in agriculture. Later, Crunkilton and Krebs (1967) introduced five key phases to consider when using the problem-solving in SBAE. Those phases included: (a) interest approach; (b) create objectives; (c) anticipate problems; (d) solve the problem; (e) evaluate and apply (Crunkilton & Krebs, 1967).

Further, Phipps and Osborne (1988) described their views on problem-solving in *The Handbook on Agricultural Education in Public Schools*. Phipps and Osborne's (1988) approach included similar elements outlined in previous works on problem-solving. For instance, their six-step method included: (a) experience a situation, (b) locate and define the problem, (c) attempt a trial solution, (d) explore reference and information, (e) arrive at a group solution, and (f) evaluate. Finally, Newcomb et al. (1993) addressed problem-solving in *Methods of Teaching Agriculture*, which appears to be one of the most recent attempts to outline the pedagogy for SBAE. In this work, the problem-solving method to teaching and learning is outlined in six steps, which were grounded in the previously reported literature. Those six steps to teaching the problem-solving approach in agricultural education included: (a) interest approach, (b) objectives to be achieved, (c) problems to be solved or answered, (d) problem solution, (e) test solutions through application, and (f) evaluate solutions (Newcomb et al., 1993). Therefore, through our analysis, it appeared that leading perspectives on problem-solving and prominent literature in SBAE demonstrated significant "pedagogical congruence" (Parr & Edwards, 2004, p. 104). As a consequence, a synthesis of these concepts was warranted to advance thought on problem-solving for SBAE.

Synthesis: Advancing the Shared Principles of Problem-Solving

To advance new understandings, we distilled shared principles from the leading perspectives on problem-solving and the SBAE literature. To accomplish this, we grounded our approach in a concept known as *consilience*, first introduced by William Whewell (1840). Consilience represents the merging of stands of knowledge from various disciplines, perspectives, and domains to offer new understandings of a phenomenon (Whewell, 1840). Using this approach, we engaged in a mapping technique to visualize each perspective's similarities and discrepancies while also acknowledging that some authors might not have specifically used the term problem-solving but in essence were describing a similar concept. A product of this procedure was the emergence of three shared principles that appear to be foundational to existing descriptions and representations of problem-solving as a pedagogy. To promote understanding, we chose to represent the shared principles using practical language in hopes that practitioners, researchers, and theorists alike might find them useful. Given such caveats, we offer the three principles of problem-solving that emerged from our analysis: (1) identify problems, (2) analyze information, and (3) evaluate solutions.

Principle #1: Identify Problems

A fundamental characteristic of problem-solving is ensuring that students have the knowledge and skills they need to identify relevant problems (Bransford & Stein, 1984; Crunkilton & Krebs, 1967; Dewey, 1910, 1938; Charters, 1912, 1924; Lancelot, 1944; Newcomb et al., 1993; Phipps & Osborne, 1988). This notion applies to whether problems are presented in the context of a classroom or in a more authentic learning environment (Dewey, 1910, 1938). To equip students with such skills, however, requires introducing them to foundational agricultural knowledge so that they can begin to understand connections, notice disturbances, and appropriately detect when an issue or problem exists (Lancelot, 1944). Therefore, developmental appropriateness is of central importance to ensure that students are prepared as they gain exposure to problems (Charters, 1924), especially in the context of SBAE. As a consequence, SBAE teachers should frame problems in ways that challenge students, but that do not trigger forms of dissonance that may be interpreted as *uneducative* (Dewey, 1910). Through a synthesis of the literature, it became apparent that to ensure students are able to identify problems successfully, SBAE instructors must scaffold them in ways that allow students to mature before they confront issues and problems of a greater cognitive complexity (Bransford & Stein, 1984; Charters, 1912, 1924; Crunkilton & Krebs, 1967; Dewey, 1910; Goossen et al., 2017; Lancelot, 1944).

Principle #2: Analyze Information

As inevitable and ubiquitous as problems are in everyday life, human beings often resist analyzing trends and other relevant data to arrive at possible solutions (Dewey, 1910; Phipps & Osborne, 1988). An essential principle of problem-solving, therefore, is to analyze information. Through our synthesis, we noted that authors of seminal works on problem-solving described a plethora of ways to collect and analyze relevant evidence. For example, articulated strategies included conducting observations (Dewey, 1910, 1938), analyzing test and control specimen (Charters, 1924), as well as generating a hypothesis based on individuals' procedural or external sources of knowledge and then assembling relevant corroborating or disconfirming evidence (Johnson, 1989). Despite the diversity in strategies available, however, SBAE teachers should ensure that students systematically collect information and evaluate it using rigorous procedures (Bransford & Stein, 1984; Charters, 1924; Dewey, 1910, 1938; Johnson, 1989, 1991).

Principle #3: Evaluate Solutions

Because problem-solving is a process, the solution emerges over time, through trial and error (Bransford & Stein, 1984; Charters, 1912; Crunkilton & Krebs, 1967; Dewey, 1910, 1938; Lancelot, 1944; Newcomb et al., 1993; Phipps & Osborne, 1988). Due to the dynamic nature of such, the evaluation of a solution is in a constant state of flux by which new discoveries can alter the beginning, middle, or late phases of the problem-solving process (Dewey, 1938; Johnson, 1989, 1991). This developmental view of the final principle, therefore, recognizes that as students learn and acquire information, an iterative progression transpires in which they co-influence past, present, and future solutions to numerous issues and problems (Dewey, 1938; Charters 1924). It is through this non-linear process; therefore, that SBAE students can critically reflect and begin to authentically evaluate whether their solution to a given problem is viable.

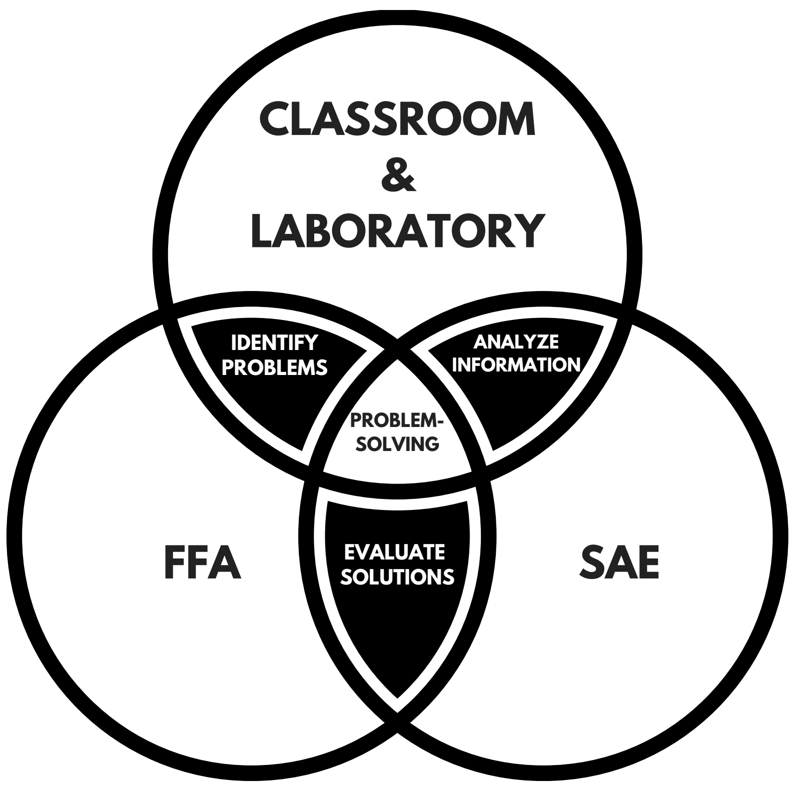
Reconceptualizing Problem-Solving for SBAE

Embedded in the three principles of problem-solving are features that stand as prominent attributes of the pedagogy. Therefore, our synthesis of ideas, theories, and models was a necessary step to illuminate how problem-solving has been advanced and used as a method of instruction. However, this process also revealed the need to expand our current view and understanding of problem-solving in SBAE. We maintain that such a reconceptualization could crystalize new possibilities for future research, theory, and practice.

For example, although problem-solving has largely been represented as a method of instruction, and rightfully so, we maintain that problem-solving's current limits and parameters in SBAE could be expanded so that it may also be viewed as a *guiding philosophy* for the discipline. To that end, we offer (see Figure 3) the Integrated Problem-Solving Model for Agricultural Education to demonstrate how this idea could be operationalized in SBAE. In the model's development, our goal was to enrich agricultural education's comprehensive, three-circle model by embedding the core principles of problem-solving – identify problems, analyze information, and evaluate solutions – in a way that would aptly depict the synergistic and complementary power of this merger.

Figure 3

Integrated Problem-Solving Model for Agricultural Education



Note. The principles of problem-solving are shaded to demonstrate their permeability through and between each dimension of SBAE.

Foundationally, therefore, the model advances the notion that problem-solving is entrenched through and between each dimension of agricultural education. Consequently, the principles of problem-solving are interwoven with the three components of agricultural education: (a) classroom and laboratory, (b) Supervised Agricultural Experience (SAE), and (c) The National FFA Organization (FFA). It is important to note that the principles of problem-solving are not exclusive to a single dimension of agricultural education. Instead, they should be considered permeable as the problem-solving process unfolds for students through trial-and-error.

To contextualize the model, we developed the following example to demonstrate how the model might be used in SBAE. To begin, consider a student enrolled in an *Introduction to Horticulture* course (Classroom and Laboratory) who noticed that the Poinsettias she planted in class a few weeks prior appeared to be stunted in growth (Principle #1: Identify Problems). To capitalize on the learning embedded in this problem, her SBAE teacher encouraged her to reflect on the learning concepts introduced earlier in the semester. After a few minutes, she answered, “Maybe it is because the plants are under the shade cloth, so they are not getting enough sunlight.” Her SBAE teacher responded, “That is a great start, perhaps, you should design a project (SAE) that will allow you to collect data to determine whether or not your hypothesis is correct.” Over the next few weeks, she collected data using control and experimental trials, and as a result, began to observe trends through an analysis of relevant information (Principle #2: Analyze Information). After this procedure, she drew the conclusion that because Poinsettias are a tropical flower, they were not getting enough direct sunlight when placed under a shade cloth in the greenhouse. She also developed a solution to this problem for individuals who may be experiencing similar issues. Because her SBAE teacher perceived she had done quality work, he encouraged her to carry out additional trails so this knowledge could be used to impact the community through a service project (FFA). As a result, she decided to work with the local FFA Officer Team to organize a professional development opportunity for senior citizens based on the knowledge she had acquired through her classroom and Supervised Agricultural Experiences (SAEs). During this session, she also asked the senior citizens to provide feedback on their experience so that she could more carefully evaluate the solutions she provided regarding growing Poinsettias (Principle #3: Evaluate Solutions). As illustrated above, the SBAE teacher wove the three principles of problem-solving throughout each programmatic dimension of agricultural education – classroom and laboratory, SAE, and FFA – for his student. Such use of problem-solving may be easy to dismiss as *common sense*. However, we counter this position on several grounds. First, what may appear to be common sense for some, may not be viewed as such by those who are new to the discipline, have little experience, or have only considered limited perspectives on problem-solving. And finally, existing descriptions of problem-solving in SBAE do not appear to have represented it in ways that capture the intricacies of the reconceptualization advanced in our philosophical discussion.

Conclusions

Problem-solving has evolved considerably since its early origins. For example, initially, it was depicted as a distinct method of instruction (Charters, 1912). However, since that time, it appears to have become conflated with other pedagogical approaches (Parr & Edwards, 2004). As a consequence, the tenets of problem-solving became ambiguous over time (Crunkilton & Krebs, 1967; Moore & Moore, 1984). In this investigation, therefore, we sought to examine existing perspectives on problem-solving and explain how problem-solving has been used as a method of instruction. Through our analysis, we conclude that six leading perspectives – Dewey, Stimson, Charters, Lancelot, Bransford, and Johnson – appeared to most profoundly influence the ways in which the pedagogy has been operationalized. From these leading perspectives, we also conclude that three shared principles of problem-solving could be distilled: (1) identify problems, (2) analyze information, and (3) evaluate solutions. The first principle, identify problems, reflected that need for educators to scaffold problems in ways that are challenging but also developmentally appropriate so that students can gain confidence before attempting to solve problems of a greater complexity (Bransford & Stein, 1984; Crunkilton & Krebs, 1967; Dewey, 1910, 1938; Charters, 1912; 1924; Lancelot, 1944). Meanwhile, the second principle, analyze information, represented the need for students to collect and analyze quality data using rigorous procedures before drawing conclusions about a problem (Bransford & Stein, 1984; Charters, 1924; Dewey, 1910; Johnson, 1989, 1991).

The last principle, evaluate solutions, suggested that because problem-solving is a process, students should evaluate their solutions to problems over time through trial and error (Bransford & Stein, 1984; Crunkilton & Krebs, 1967; Dewey, 1910, 1938; Charters, 1912, 1924; Lancelot, 1944; Newcomb et al., 1993; Phipps & Osborne, 1988). Although our distillation of the shared principles helped describe how the pedagogy has been operationalized as a method of instruction, it also called attention to the need to expand our current use of problem-solving. Therefore, we introduced the Integrated Problem-Solving Model for Agricultural Education, which advanced the principles of problem-solving embedded through and between each component of agricultural education's comprehensive, three-circle model: (a) classroom and laboratory, (b) SAE, and (c) FFA. We argue, therefore, that problem-solving can not only be operationalized as a pedagogy but also a guiding philosophy for SBAE moving forward.

Implications, Recommendations, and Discussion

In recent decades, a growing number of voices from business, government, and higher education have called for more curricular focus to be placed on enhancing agriculture graduates' ability to communicate, think critically, and innovate (Blickenstaff et al., 2015; Fields et al., 2003). By fostering these process-oriented skills, it is reasoned that future agriculturalist who enter the workforce will be better prepared to traverse a world fraught with complexities that require them to adapt and solve problems on issues such as climate change, disease, global hunger, and water scarcity (National Research Council, 2014; Roberts et al., 2020; Warren English et al., 2018). In response, this philosophical investigation illustrated the ways in which SBAE could draw on its problem-solving foundations to reposition itself, as the headwinds of change threaten to intensify in the 21st Century and beyond (Brown, 2016). However, such a reorientation will be complex for the discipline to adopt, with even basic discussions about this change, presenting numerous conceptual and practical hurdles.

As a consequence, we offer the following possibilities for future research and practice. First, more dialogue is needed about problem-solving, when conceptualized as both a method of instruction as well as a guiding philosophy for SBAE. To achieve this, perhaps professional development sessions could be offered by the *American Association for Agricultural Education* (AAAE) and the *National Association of Agricultural Education* (NAAE). A concerted effort should also be dedicated to diffusing the Integrated Problem-Solving Model for Agricultural Education. As such, we recommend the model be shared, along with illustrative case study examples, in *The Magazine* as well as the *FFA New Horizons*. Teacher educators should also introduce the model to preservice teachers by having them consider innovative ways to integrate such into their future SBAE programs. We also suggest that podcasts, popular press articles, and other communication mediums promote SBAE students, advisors, and programs that use the model in exemplary ways. Finally, we recommend the use of social network analysis to analyze the model's diffusion challenges better by identifying opinion leaders who influence others in SBAE at the node, dyad, and network levels (Borgatti et al., 2018).

Although problem-solving has a deeply entrenched philosophical foundation in SBAE (Moore & Moore, 1984), more work is needed to explore its dimensions. Therefore, we recommend that research be conducted to examine the programmatic outcomes associated with use of problem-solving as a guiding philosophy. For example, does such an approach improve students' career readiness, creativity, critical thinking, engagement, learning, and motivation (Roberts & Robinson, 2018)? Further, what motivates a SBAE instructor to adopt such a philosophy in an individual program? Additional research is also needed to examine the outcomes of problem-solving's use as a method of instruction in SBAE. As an illustration, how do the ways SBAE teachers conceptualize, use, and talk about problem-solving affect student outcomes? And do students who solve problems through team-based learning approaches learn better than those assigned individual problem-solving projects (Figland et al., 2020)? These corollary questions warrant further examination.

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Teacher Disengagement in High Stakes Learning Environments: An Ugly Data Perspective

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Teacher Disengagement in High Stakes Learning Environments: An Ugly Data Perspective

Abstract

A lack of engagement has been reported to contribute to an ever-widening gap between how students develop knowledge, skills, and abilities and how teachers provide instruction. At the onset of this study, the purpose was to understand how depth and sequence of experience influenced student engagement, yet an emergent etic perspective surfaced. Data were collected from hundreds of hours of student interviews and observations, student and teacher reflexive journals, and classroom dialogue. Results of this study included a personal autoethnographic narrative describing the complex and unforeseen realities of (dis)engagement experienced by teachers and students. At the conclusion, it was evident the scope of the study needed to be expanded to not only describe the influence of how depth and sequence of experience engaged and, in some cases, disengaged students and teachers alike, but also the role meaningful connection plays in teaching in high stakes learning environments.

Introduction

Engaged students are more motivated to learn but understanding how to engage students is a complex task (Coates, 2007). Teaching and learning are not mutually exclusive. The ability of a teacher to engage students is met with an unlimited number of extraneous variables and ever-changing policies that continuously disrupt their daily approach. Issues of student engagement become more difficult in high-stakes educational settings. According to the National Research Council (1999), the context and standards of high-stakes environments have unintended consequences that discourage teachers from improving instruction to engage students. Additionally, teachers exhibit more controlling behaviors and are less likely to use practices that support student engagement, including exploration and experimentation (Sheldon & Biddle, 1998; Bain, 2004).

The challenges of teaching today's student require teachers to adapt to a new reality that is far from the classroom many educators experienced as students. Priority 4 of the *American Association for Agricultural Education National Research Agenda* (Edgar et al., 2016) included the need to understand "meaningful, engaged, learning opportunities is paramount to future learning environments," signaling a "paradigm shift" in the way teachers prepare students for the 21st century (pg. 38). However, perceptions that foster ideas of "*edutainment*" and quick fixes to student engagement only create misrepresentations of the problems teachers are facing in their classrooms (Sorathia & Servidio, 2012). Teaching, without renewed perspective of learning, may create an ever-widening gap between how students develop knowledge, skills, and abilities and how teachers provide instruction. In adapting the learning environment to also "entertain" students, teachers are taking on additional responsibilities in the classroom; teachers' past experiences and current social, emotional, and mental states can largely affect these additions. To understand engagement, holistic accounts of student and teacher experiences should be considered. Assessing both parties allows researchers to identify levels of engagement in relation to classroom culture and learning expectations.

The complex web of perspectives, approaches, and settings presents the need to understand student and teacher engagement at a basic level. Bain (2004) suggested "the best teaching cannot be found in particular practices… but in the attitudes of teachers, in their faith in students' abilities to achieve, in their willingness to take students seriously, and let them assume control of their own learning" (p. 78-79). In line with the learning process, teachers must consider their inevitable impact on student learning – experiences, both positive and negative, will impact student learning as well as the overall classroom environment. Although research has contributed to varied components of teaching and learning individually, a collective and reciprocal understanding could illustrate possible opportunities for teachers *and* students to engage in any learning environment – including all five disciplinary areas of our profession (agricultural communications, agricultural leadership, school-based agricultural education, extension and outreach education, and agricultural education in university and post-secondary settings).

What is Student Engagement?

Engaged learning practices used to develop students into in-depth learners, instead of passive receptors, have been essential components of educational theory for years (Johnson et al., 2001; National Research Council, 2009). Drawing on constructivism, engaged learning requires students construct knowledge with their own experiences instead of accepting the experiences of an all-knowing teacher (Piaget, 1976). In higher education, Chickering and Gamson (1987) provided a set of principles to engage undergraduates in learning; principles include student-faculty interaction, student cooperation and reciprocity, and active learning.

Developing a specific definition of student engagement has become increasingly important as researchers and administrators work toward practices to improve student performance. Krause and Coates (2008) defined student engagement as "the extent to which students are engaging in activities that higher education research has shown to be linked with high-quality learning outcomes" (p. 493). Similarly, Hu and Kuh (2001) defined engagement as "the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes" (p. 3). Harper and Quaye (2009) argued engagement was a more complex matter that required more than an understanding of time and effort. In their view, involvement without feeling engaged was simply compliance; students must feel an emotional connection to make meaning of their experience.

What are the Benefits of Engaging Students and Teachers?

Dewey (1938) defined the most powerful learning experiences as those that engaged the human mind in meaning-making. Dewey believed the most educative learning experiences allowed learners to solve problems and build understandings through interaction with the world around them. Although students were the primary concern of most researchers in the literature, Magolda (2005) contended they're not the only ones to benefit from increased engagement in the learning process. The reciprocal environment constructed to engage learners fosters increased teacher engagement as well (Magolda, 2005). Although the literature is rarely focused on the benefits increased student engagement has on teachers (at any level), the benefits can be inferred. For example, increased faculty-student interaction resulted in greater job satisfaction (Bensimon & Dowd, 2009) and feelings of connectedness for faculty members (Kuh, 2009).

Although the benefits of incorporating student engagement practices are well documented in the literature, there is little to illustrate the consequences of disengagement beyond mere observation of what teachers may perceive as disengaged behaviors. Further, rarely have both student and teacher data been viewed simultaneously to understand the reciprocal nature of (dis)engagement in teaching and learning.

Purpose

This study is a snapshot of a larger study describing and comparing how and when experience engages students in the learning. Although this study was an unanticipated outcome the phenomena of *teacher disengagement* lends insight to challenges to teaching post-secondary courses in agriculture. Therefore, the purpose of this study was to illustrate or story the phenomena of teacher disengagement as an emergent etic perspective and consequence of implementing deep, prolonged instructional experiences in a post-secondary environment.

Research question: How can implementing deep, prolonged instructional experiences in a post-secondary environment affect student and teacher (dis)engagement?

Theoretical and Conceptual Framework

Shame Resilience Theory (SRT; Brown, 2006) provided structure to understand how individuals experience shame in high stakes environments. Brown's theory, including the shame web depicted human interaction, specifically female in current research, can be explained best by understanding the variables associated with shame and the relationship between experiences with shame and performance standards. Initially, Social Cognitive Theory (SCT; Bandura, 1986) provided bounds for data collection; SCT allowed data to be categorized by the interaction between people, environment, and behavior. By viewing personal characteristics as reciprocally altered by behaviors and environments, researchers can view people as both creators and products of their experiences and understand the way individual thoughts and feelings affect the different ways people approach the world (Bandura, 1986). In providing detailed accounts of individuals' personal experiences, researchers can view academic experiences with a more fluid set of expectations, including experiences with shame.

Originally, data collected during student and teacher reflections were framed using SCT (Bandura, 1986) in an attempt to categorize deep, prolonged instructional experiences in a post-secondary environment using personal and environmental determinants as stable concepts or variables. After analyzing the data, Shame Resilience Theory (Brown, 2006) proved to frame the data in a more descriptive and honest way, including additional variables for behaviors recorded in the original study. Admittedly, data from the original study proved more colorful when viewed in the context of SRT. The change from SCT (Bandura, 1986) to SRT (Brown, 2006) allowed for data to be analyzed in full context of the experience with greater understanding of the connection between variables associated with shame and performance expectations within a high stakes learning environment.

Method

This autoethnography was part of a larger study that spanned one calendar year—three academic semesters (spring, summer, and fall). Although the findings were focused on phenomena of teacher disengagement, the context of the course, activities, and students enrolled contributed to the findings. The larger inquiry included four cohorts with varying levels of deep, prolonged experience. Forty-two students (six male, 36 female), between 18 and 25 years of age, agreed to participate after enrolling in one of four sections of an undergraduate social science research methods course. Students represented four majors: agricultural leadership development, agricultural science, agricultural communications and journalism, and animal science.

When this study was conducted, I was a graduate student, and I co-taught the research course with my dissertation advisor and committee chair. Our students were involved as both participants and researchers. Specific learning objectives were aimed at developing students' abilities to access information, think critically, and present and support reasoned arguments. However, students studied engagement by evaluating theories, collecting data from other populations, while also being introspective about their own engagement in the course.

Design

Although the larger study was an abductive, longitudinal, quasi-experiment the emergent etic perspective storied here was autoethnographic in nature. Autoethnography is a method of rigorous self-reflection and reflexivity that relies on the personal experiences of the researcher to describe and evaluate beliefs, practices, and experiences (Ellis & Bochner, 2006; Adams & Manning, 2015). By nature, "autoethnography is messy, uncertain, and emotional" (Adams et al., 2014, p. 19). The ability to use a research method to both accommodate for and acknowledge the difficult realities of social life helped make meaning of my experiences struggling within a larger hyper-structured research design.

Sources of Data

Data were extracted from more than 200 hours of interviews, four cohorts, and six hours of class per week, additional research meetings, conversations, and informal interactions of unknown amounts of time, and six weeks of immersive field experience. Additionally, quantitative data were collected from four commercially available instruments and used as artifacts to further increase the credibility of findings through data triangulation (Lincoln & Guba, 1985). Although the findings presented in this study only include data from observations, reflexive journals, student-teacher dialogue, and countless hours of rigorous introspection, the influence other sources of data may have had on my interpretation cannot be untangled.

The Human Instrument

Lincoln and Guba (1985) provided characteristics that "qualify the human being as the instrument of choice for naturalistic inquiry" (p. 193). Unlike most quantitative instruments, human beings are adaptable and "like a smart bomb, the human instrument can locate and strike a target without having been preprogrammed to do so" (Lincoln & Guba, 1985, pp. 193-194). As the primary instrument of data collection, I viewed this process from a nonlinear perspective, but had the flexibility to use quantitative artifacts as sources of data. Data, regardless of method or source, were used to mold, adapt, and continuously calibrate the human instrument.

Observations, Journals, & Dialogue

Observations were made before, during, and after each class and research meeting and during the entire field experience. As an active participant in the experience, I was able to capture interaction, be inductive, and observe behaviors beyond what students would divulge during an interview (Patton, 2015). Observations brought my own perceptions to light as well as the perceptions of students as recorded in their reflexive journals.

In addition to my own journal, the reciprocal nature of the larger study required my students keep reflexive journals to reflect critically on the "human as instrument" (Guba & Lincoln, 1981). Journals served as a reservoir for thoughts, feelings, observations, and field notes. Together, we chronicled the learning process while calibrating our instruments through self-discovery and interrogation (Lincoln et al., 2011). Journals provided insight to distinctive voices each of us brought to the classroom and led to a greater understanding of the multiple perspectives that framed the learning process (Alcoff & Potter, 2013).

Students engaged in a constant exchange of thoughts and ideas that served as both a source of data and method of learning. Specific attention was given to Socratic dialogue to help unlock implicit ways of thinking and insights not previously explored by the group (Given, 2008). Many times, our Socratic sessions would occur spontaneously outside of the bounds of class meetings and usually near a white board. Our concepts, models, and brainstorms were captured in photos to visually recall and interpret the experience along the way.

Trustworthiness of Findings

Lincoln and Guba (1985) outlined techniques for establishing trustworthiness to ensure findings are reached in a systematic and disciplined manner. Trustworthiness techniques mirror evaluation criteria found in quantitative research and provide increased "inspectability" of data and findings. I used multiple techniques to enhance trustworthiness of findings including prolonged engagement, persistent observation, triangulation, audit trail, peer-debriefing, member-checks, reflexivity, and thick, rich description. Extensive records (reflexive journals, sketchbooks, pictures of conceptual designs and models, and process and personal memos) were kept for confirmability and constant comparison of significant statements, codes, and emergent themes. A coding structure was used to ensure a detailed audit trail and is as follows:

Student data: *Ex: 014_BR2_079*

1) Student participant code (01 - 042); 2) Source of data (BR = Black and Red journal, SB = Sketchbook); 3) Page number = (001 – 175)

Teacher data: *Ex. FN_BR3_104*

1) Research activity (OBSV=Observation, FN = Fieldnote, RF = Reflection.); 2) Source of data (BR = Black and Red journal, SB = Sketchbook); 3) Page number = (001 – 175)

Data Coding, Analysis, and Presentation

The task of understanding ethnographic data lies in the ability to condense mass amounts and sources of data (Merriam, 1998). I originally approached coding in a very inductive manner, using *in vivo* coding, descriptive codes, and deductive codes based on the framework of SCT (Miles et al., 2014). However, the use of SCT proved to hinder the analytic process when considering the reflexive nature of my own data. I continued with the coding process despite my frustrations; I inductively analyzed and coded data, developed additional codes to describe unexpected elements that emerged, and placed each into a matrix where they were continuously sorted into primary, secondary, and tertiary themes. It was not until much later that I discovered the process of analyzing data was not an exact science. Therefore, data were then viewed as analytic memos where I recorded additional elements of how the coding process took shape (Saldaña, 2016). The resulting findings were presented with student data alongside my own using verisimilitude—a literary strategy that captures the researchers' thinking processes and attempts to realistically convey the intricacies of the experience with thick, rich description—thereby, enabling readers to reconstruct the experience for themselves (Creswell, 2009; Lincoln & Guba, 1985).

With consideration for my relationship to the data and the difficulty experienced during analysis, SRT (Brown, 2006) was introduced as an alternative to SCT and data were analyzed for evidence of emotive response, specifically shame. Shame data, in the context of high stakes learning environments, must be considered when studying unintended consequences of student-teacher (dis)engagement. In *Shame Resilience Theory: A Grounded Theory Study on Women and Shame*, Brown identified five main concerns of shame: what are the participants describing, what do they care about, what are they worried about, what are the participants trying to do, and what explains the different behaviors, thoughts, and actions (Brown, 2006, p. 44).

Findings

Words are Hard

Native Language

I began this process in search of a way to make learning research more engaging. After considering various methods of classroom engagement, my teaching partner and I decided to forgo traditional teaching methods by avoiding the use of research terminology in class. Instead, we used common language so students might discover terms on their own and attach those words to experiences as they came about. For me, it was pretty easy to adhere to our native language because as a graduate student, research terminology was new to my everyday vocabulary. However, my partner had been using research jargon for eight years and the transition was difficult. *Words are Hard* quickly became a classroom hashtag and constant reminder to communicate in a way our students understand.

Research as a Second Language

The hashtag, #wordsarehard, became a fun "game" for our students. Our open and transparent process left very few things unsaid in our classroom, and students quickly caught on to the struggle we were experiencing with words. For students, myself included, research was a second language and "unlocking" new words was exciting… at first. For example, after observing other [University] students at various locations on campus, our students began to describe the various behaviors, environments, and personal characteristics they had observed. As one student wrote in his journal, "[Teacher] gets so excited when we figure things out. I need to Google Social Cognitive Theory" (07_BR1_014). My journal entry echoed their observation that day. *FN_BR1_029: It's working! It's really working! #wordsarehard #proudteacher.* I was motivated to provide them with experiences and attach terminology after they understood meaning. It seemed crazy, but research was becoming our second language and after years of learning terms just to pass a test, we were interested in how they became a permanent part of our vocabulary.

Language Acquisition through Experience

As time passed, words including "sample," "instrument," and "analysis" started to creep into our classroom discussions. Instead of discussing what might occur during an observation, interview, or face-to-face survey, students experienced issues first-hand and shared their successes and failures with our class. The chance to rifle through their experiences made it easier to share new terminology as we evaluated the process of understanding people. Although students seemed to be refreshed (or maybe just relieved) by the lack of terminology, a few also expressed a bit of confusion and annoyance with the process. One student was hesitant to speak up in class, but wrote "How is observing some people at the [student center] relevant to any kind of actual research" (013_BR1_018). Another student wrote, "Just give [the terms] to me. I know how to do research! I'm tired of waiting around for you to give me information" (06_BR1_027). I wanted to understand their point of view but was irritated with their impatience. After returning to interview and preliminary data, I saw the shared connection. Both students were double majors in animal science and predisposed to research in the basic sciences. In a way, they were ahead of the rest of the class (and always would be), but reflections provided more insight as each progressed. One wrote, "Observations seemed like useless collections of information. I now see it was the beginning of understanding a larger process" (013_BR1_018).

Native Language Attrition

Much to my surprise, as students gained efficacy with research terminology, I did too. Soon, my normal contributions to office banter were replaced with "what's your unit of analysis," and "what if we used a different conceptual framework?" I noted this transition after reflecting on time back home with friends. *FN_BR3_062: When will I realize that not every lunch requires #researchtalk? I'm blabbering. THEY DO NOT CARE. Obnoxious!* I found it only got worse as time went on. Research permeated my every interaction from my first cup of coffee in the morning to the text messages I sent before bed. Phone calls with my mom became more difficult and I could no longer explain to her what I had been up to. My "research buds" shared Piled Higher and Deeper (Ph.D.) comics on Facebook poking fun at the phenomena, but I had a hard time finding humor in our shared experience. *FN_BR3_079: So much for being a great communicator! Might as well live under a rock.* Because I had surrounded myself with peers in the same situation, the issue didn't really become a problem until a new crop of students began the second phase of this study. Everything I prided myself on was slipping away.

FN_SB2_012: Why can't I connect with them? I'm a teacher, damnit! Or am I? :(

Lost in Translation

In almost an inability to remember what it was like to struggle with the research process, I found it more difficult to engage the final cohort of students like the first. *FN_BR3_104: There's a gap between cohorts that I don't really understand quite yet. They are struggling. How do I make this better? I'm at a loss here.* It seemed my newfound connection to research terminology and the process of doing research left it difficult for me to connect student learning to new experiences and new experiences to student learning. The first cohort seemed to embrace new terms because they were anxious to finally get them. They anticipated them. They wanted them. The second cohort, however, didn't seem to make connections in the same way. In some cases, the words seemed to pass by the experiences as if students were simply going through the motions. More times than I would like to admit, students wrote things like, "is she even talking to me?" or "I'm over trying to understand this class." It hurt, but they were right. I was speaking a foreign language and oblivious that my connection was lost somewhere in translation. In feeling loss of teaching and communication skills, I was forced to reflect on differences emerging in the data, specifically my own – I spiraled into web of shame (Brown, 2006).

Gut Punch: Cognitive Dissonance & Reciprocal Engagement

"How can you expect me (student) to be engaged when you (teacher) aren't?" (16_BR1_064)
FN_BR2_084: Stop the bus. What did she just say? Are you kidding me?!

Owww

I have no recollection of what I said in response to [student] that day, but I was completely taken aback by her comment. We had intentionally built an environment where students could feel comfortable saying things like this, but I doubt my response was indicative of that effort. I was angry. *FN_BR2_084: I'm giving everything I've got over here. Who do they think they are?* I spent the next few hours sitting at my desk ruminating on the remark. I started to wonder if we had given students too much power and freedom in the classroom. *FN_BR2_085: This is why structure is important. She would never say that to [faculty member].* My rant continued on the next two pages and finally subsided with a final thought.

FN_BR2_087: Oh, wait. I told her to do that.

Cognitive Dissonance

The original remark about my perceived level of engagement resonated in eleven other student journals (all but two students' present) that day. Students began to question my general level of interest and motivation in the course. It was pivotal. I spent weeks (and months, really) thinking about how many times I teach students to do one thing, while modeling a completely different behavior. I also considered the times I observed this type of behavior from my own teachers and mentors. This insight became a magnifying glass, of sorts, and I began examining almost all of my interactions. Could something as simple as "walking the walk and talking the talk" be paramount to this study? *FN_BR3_012: "Do as I say, not as I do." Looks like Dad's old mantra is coming back to haunt me.*

Although my reflection may seem trivial, to me it was revelatory. This study was originally designed to understand students and the experiences that engage them in learning, but all the while, I may have been looking in the wrong direction. I literally told them (on the first day of class) I wanted to find a new way. I told them I believed engagement to be a two-way process and I wanted their open and honest feedback. Yet, there I was ignoring my own levels of engagement. Even more, I was wrought with fear that others (faculty, mentors, etc.) might discover my less than stellar performance and quietly ask me to pack my things. In retrospect, that was a silly thought, but the stakes seemed so high at the time and I was far from hitting the mark. She [student 16_BR1_064] provided the one piece of information that changed the way I considered this study, twelve little words that haunted my brain for months. It broke my spirit, but enlightened my path.

Autopilot: The Harsh Reality of (Dis)engagement

"You are different, beautifully so, and people will benefit from your perspective.

Your words mean something. This experience is teaching you far more than what can be observed – it's teaching you to believe in you." (06_SB1_003)

The excerpt (06_SB1_003), above, was written on a postcard and taped face down into the pages of a student's sketchbook. I thumbed through several times, never giving them too much thought, but once the tape started to give way, this postcard flipped over. It was one of ten she planned to send as little reminders to herself when she arrived back home. Lucky for me, she forgot to send them, and that afternoon, I sat by myself, read through each one, and bawled my eyes out.

FN_BR2_114: I'm exhausted.

When *teachers* say, "I'm exhausted", I don't really believe that's what they mean. I'm sure they are tired and may *think* they are exhausted, but what I really *hear* them saying is, "I'm not excited about what I'm doing right now." When *teachers* are *engaged*, they ignore being tired; they're in the zone and running on fumes of passion.

FN_BR2_115: I'm really exhausted.

I recognize the blatant contradiction here, but that doesn't change the reality of its occurrence. Comments like the one above peppered my field notes during the last six months of this study. I was ashamed to write down thoughts like, "What am I doing?" or "I don't want to be here," so I didn't, but they occurred nearly three times as much. *There I said it. I was on autopilot.*

The shame of thinking these things, let alone including them in this study, was paralyzing. The idea of being "called out" for a *less than perfect study* because I was a *less than perfect* teacher was more than my pride (and future career) could take. I felt like a big ole' phony. Surely, I wasn't the only one to ever feel this way, right? *Right? Do you think anyone else knows?*

When *students* say, "I'm exhausted", I don't really believe that's what they mean. I'm sure they are tired and may *think* they are exhausted, but what I really *hear* them saying is, "I'm not excited about what I'm doing right now." When *students* are *engaged*, they ignore being tired; they're in the zone and running on fumes of passion.

"I'm exhausted" (38_BR1_071).

Huh? It was like some form of black magic. My students couldn't possibly be experiencing the same thing. *We're different. They don't know what I know.* The rare occurrence of this finding in the literature made the connection between my data and my students' data even more difficult to accept. I needed some reassurance. *FN_BR3_099: HELP!! I give up. This is impossible.*

Cold Hard Truth

This study took me down a long, circuitous path. Communicating the findings (on paper) has been a monumental task, but I have told this story (to anyone who would listen) every day since it began. I wrestled with my own experiences— both teaching *and* learning—at every turn. I questioned and resisted what I considered to be "conformity;" I've been angry, frustrated, and disenchanted; and I developed a pretty large chip on my shoulder, too. *FN_BR3_047: How can I* *communicate this experience? How do I adequately portray my own disengagement? How do I describe how much I've changed? I don't even feel like a teacher anymore. I'll never get a job after this.*

To this point, the "pieces" or themes were like vignettes that lined the walls of my heart and mind for months, but they remained static without understanding the experience more holistically. The fact is, "words *are* hard"—hard to articulate, difficult to write, painful to digest, and often lost without the ones around them. The larger study began with specific research questions concerning the influences of experience on student engagement, however, "the path of discovery is not clearly marked, nor should it be" (Thorp, 2001, p. 37). I could have easily described student engagement throughout the entire study, outlined findings of the hyper-focused quasi-experimental design I set out to follow, and provided more direction for others to build on for the future, however, that would have alienated the most glaring pieces of data—my own. Identifying and addressing my experience within a high stakes learning environment provided insight into the concept of shame resilience. In addressing my own professional and personal experience with shame, I moved forward while highlighting what seems to be an emerging reality in high stakes academic environments – honest data reporting. In sharing this data, my feelings of powerlessness and isolation decreased when I invited others in. After letting go of the many ways this piece might be perceived and how that perception might affect my future career, I created more experiences with empathy, connection, power, and freedom than I could have ever expected (Brown, 2006).

Discussion

As the case with most naturalistic inquiry, the purpose of this study was not to infer to a larger population. Rather, the intent was to understand an unanticipated and, arguably, unfortunate phenomena: Teacher disengagement. Not only is the literature describing this phenomenon vague, it may be nonexistent. While teacher engagement is critical for the learning process, student expectations seem to be the immediate point of discussion. It's important to mention the relationship between expectations and engagement – if expectations for learning or instruction are not met engagement will suffer for both teacher and student (Majkowski & Washor, 2014).

Experience was noted in no less than five of the seven research priority areas of the *National Research Agenda* (Roberts et al., 2016). Further, the history of, need for, and value of integration of experience into agricultural education environments was thoroughly noted by Baker, Robinson, and Kolb (2012). Despite the expansive number of researchers who have recommended integrating experiences into the educational environment, few have noted many of the potential unintended consequences of implementing deep, prolonged instructional experiences in a post-secondary environment. The occurrence of these consequences is not likely a new phenomenon. Yet, the implications of presenting *ugly data* or the unintended consequences of a study are not widely present in the agricultural education literature. Therefore, several elements should be investigated and considered by future studies:

Issues with Unrealizable Objectivity

Although it may seem as if I abandoned the design of this study somewhere along the way, that is not entirely the case. The design was like a too-tight sweater, uncomfortable but difficult to throw away. The truth is I became so focused on design that I had a difficult time connecting with the most important and significant part of my study: *my students.* It was important for me to tell that story, to illustrate the ways in which this study changed because I changed and allow the reader to come to conclusions on their own. Ignoring the growing pains would have omitted the difficult truths of an unrealizable objectivity – something I'm afraid is all too common in our research, but rarely explored. Reflecting on the power of vulnerability within the context of shame helped untangle this phenomenon; speaking shame is a pivotal opportunity for increased personal understanding and the development of personal and professional strategies for resilience (Brown, 2006). My attachment to design, and the research process for that matter, made it difficult for me to engage in the very environment I created. My quest to understand the complex nature of people and social interaction was beset by my transition from teacher to researcher. I was no longer the responsive and adaptable educator, but instead a rigid and design-focused researcher. I experienced the shame of foregoing a past pattern of thought by adopting the accepted norms of my high stakes environment, both losing and acquiring skillsets along the way.

Meaningful Connection in High Stakes Learning Environments

The process of learning new information is only engaging for so long without a personal connection between teachers and students. Harper and Quaye (2009) argued student engagement required more than an understanding of the teacher's time and effort. The findings of this study provide evidence to support the influence of time and effort, but also raise questions of where that time and effort should be placed for effective learning. In this case, I placed the most time and effort on the *process* of conducting research instead of the *people* involved. I lost the connection with students when I stopped being responsive to their needs. There was no meaningful emotional connection to help make students connect to their learning experience, thus altering the overall learning environment. My commitment to *people*, to *teaching people* was ignored in my attempt to produce high quality research (Brown, 2006).

Might the high-stakes environments discussed by the National Research Council (1999) be to blame for the unintended consequences of disengagement by both students and teachers? Could the pressures of producing high quality research discourage teacher-researchers from improving instruction to engage students? Or is it simply the nature of research to become detached when adhering to focused and structured designs? Future research should consider the environmental and internal factors associated with faculty and graduate student expectations as it relates to student and teacher (dis)engagement in higher education; specifically, experiences with shame in academia and willingness to report honest data. Social scientists should consider moral and ethical implications of such, especially when expressing the realities of praxis in teaching and learning.

Connection Between Student & Teacher Experience

Often times, research considers the issues of student engagement independently from teacher engagement, providing a host of strategies to foster a better learning environment. However, rarely are variables considered side-by-side in a more holistic way. In doing so, it may be easier to notice the behaviors exhibited by students are not all that different from their teachers. Future research may benefit from observing engagement as a more universal phenomenon affecting teacher and student behavior similarly. Mojkowski and Washor (2014) contend student disengagement to be a deeper issue than previously believed. Student expectations are driving disengagement concerns. Students are struggling to fit into restrictive academic environments; therefore, a shift is necessary to focus on sustained engagement practices: relationships, challenge, play, relevance, authenticity, practice, choice, application, time, and timing (pg. 9).

The Problem with Theories

Although SCT was not the guiding force of this study, it served as a point of reference when considering factors of teaching and learning. At a granular level, factors suggested to change engagement were easy to understand, but the bigger challenge required I consider the way each and every interaction changed the next. It was a sequence of interactions, changes, and behaviors too large for me to see alone and the belief that a simple formula might uncover one solution was short-sighted. The simplification was intended to guide understanding, but a more complex analysis was needed. Literature identified SRT (Brown, 2006) as a means to shorten gaps of understanding and widen perspectives. SCT provided firm bounds for the study to begin while SRT provided a fluid construct for the data to exist.

The static and predictable nature of theories may lead people (especially young researchers) to believe the findings of this study (or any study for that matter) are merely formulaic in that the same person, doing the same thing, in the same way would provide the same answer every time. However, formulas are rigid and conventional, and albeit mathematical, function as a way to solve problems--human or otherwise. The sheer number of variables needed to consider the dynamic interaction between students and teachers during the process of learning is overwhelming, but should be considered, nonetheless. Might some teachers be restricted when conceptualizing teaching and learning as a formulaic process?

I contend student and teacher engagement, and thus, (dis)engagement to be more of a complex algorithm that adapts and changes. Although key "formulas" may make up an engagement algorithm, those formulas, the way they are arranged, and the many ways in which they change is more complex than what I could understand during the course of this study. Understanding the way this study emerged and the gravitational-type pull environment played in our findings would be too complex of a task without the consideration of a larger, adaptable algorithm. Future research should consider student and teacher (dis)engagement as an algorithm that stretches and changes in new, more dynamic ways. One potential method of inquiry is an algorithm based in SRT. Establishing a conceptual algorithm based on SRT may provide context for evaluating teachers in a complete emotional, social, and mental context. Understanding engagement with students and teachers demands an adaptable framework for teaching and learning.

New Methods in Agricultural Education

Ok. Hear me out. Many of the struggles of this study and my ability to adequately describe my experience may lie in our professions level of discomfort with more uncommonly used methods. As a graduate student, I worked alongside my mentors to develop a quasi-experimental study to "increase the rigor" associated with Agricultural Education research in the social sciences. All the while, this design held me back from truly understanding the phenomena at play. *I struggled.* I sought out additional qualitative methods, but rarely saw those methods in the pages of our journals. It seemed (to me) that I must adhere to a more structured design if I wanted to succeed. Might young researchers be hindered by our collective distaste for new methods? How can we mentor young researchers in rigorous methods spanning paradigms? What does the future of

Agricultural Education (broadly defined) look like when young and old researchers alike struggle with making sense of a too tight and seemingly sterile science in a socially constructed discipline? Could the introduction of theories similar to the open-ended study of shame resilience provide a greater insight into teacher-student experiences? How do we help? *Help.*

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Assessing Teacher Practices Related to Precision Agriculture in Secondary Agriculture Education

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Assessing Teacher Practices Related to Precision Agriculture in Secondary Agriculture Education

Abstract

Agricultural education was designed to reflect the agriculture industry, and since the recent increase in technology use in the industry, little research has been done to investigate what agricultural technologies are used in secondary agriculture classrooms. Secondary agriculture instructors in Alabama and Illinois participated in this study and provided descriptive data about their personal characteristics and their decision to incorporate precision agriculture, as well as barriers that prevent them from incorporating precision agriculture concepts. This study identifies the curriculum involving precision agriculture that is currently being taught and gains insight into teachers' decisions to integrate precision agriculture in their classrooms. Teachers indicated the importance and relevance of precision agriculture, but only half of the participants incorporate related concepts into their curricula. A Chi Square test revealed no significant relationships between the personal characteristics of teachers and their decision to incorporate precision agriculture concepts. The most important topics in precision agriculture were identified by participants as: GPS, Soil Sampling/Land Management and Genetic Modification. Teachers indicated a need for professional development or teacher education focused on precision agriculture in multiple fashions and supports the need for similar education in the agriculture industry.

Introduction

Agriscience education is a lifelong journey of instilling foundational content skills, developing experiential learning opportunities for a well-trained 21st century student, and focused professional development for the agriscience teaching profession. Secondary agricultural educators have consistently demonstrated interest and value in promoting agricultural technologies for student learning. Agriscience educators have been urged to push the bounds of instructional innovation for over 115 years as reported by Wallace's Farmer (1908) and cited by Hillison (1995) "if the director could introduce the teacher to lay aside the book and present problems likely to come up in farm life, it would tend to make a good deal better farmer[s] out of the next generation" (p. 8). Although the statement was limited to traditional agriculture students of the early 1900's the pragmatic context is just as profound today. Understanding practices and rationale for the inclusion of precision agriculture content in new and existing curricula may serve as a model for other programs and schools seeking to enhance the practicality of today's modern agricultural education classroom. Precision agriculture inclusion is a vital component of instructional innovation in the secondary agriscience education classroom (Palak & Walls, 2009) and requires a unique set of teaching and learning competencies to reflect historical agricultural changes (Ruffing, 2006). Identifying the tenets that promote or inhibit the adoption of innovation (Rogers, 2003) relating to precision agriculture content in the secondary agriscience classroom is vital to continued growth and success of global agriculture. Glenn (1997) wrote "public support for technology instruction is strong and vocal, and there is an expectation that no school can prepare students for tomorrow's society of new technologies are not available for students" (p. 123). To understand the perceptions of secondary agriscience education teachers' instruction of precision agriculture we need to understand the rationale in which precision agriculture content is embedded in agriscience curricula. Identifying the relevance of precision agriculture in existing course pathways will explain the perceived importance of precision agriculture instruction to secondary agriscience teachers. Determining the perceptions and barriers of the curricula associated with precision agriculture instruction as described by Kotrlik et al. (2003) may identify detractors limiting precision agriculture content in agriscience courses.

McBratney et al. (2005) defined precision agriculture as "the[sic] kind of agriculture that increases the number of (correct) decisions per unit of area of land per unit of time with associated net benefits" (p. 8). Precision agriculture has been characterized as using standardized methods such as crop rotation and fertilizer application to increase yields. Advances in information technology have created the opportunity to farm in a more customizable way that allows agricultural producers to make informed management decisions (Lowenberg-DeBoer, 2015). Consumer demands for efficiency and environmental conscientiousness in agriculture have reduced inputs, increased efficiency, and improved yields. These practical applications shape the agricultural industry into a sustainable and efficient production model for the growing population. Global positioning systems, soil mapping, variable rate planting, unmanned aerial vehicles, and yield mapping represent new and emerging technologies and serve as an opportunity for inclusion in secondary agriscience education classrooms. Kotrlik et al. (2003) reported the difficulty of integrating technology instruction in secondary agriscience education classrooms as difficult, time consuming, and resource intensive.

The training and education for consumers of technology as well as specialists who are able to install, troubleshoot, maintain, educate, and develop emerging technology is increasing in demand. Kitchen et al. (2002) reported a lack of sufficient and effective education opportunities for producers, teachers, and students of precision agriculture technologies exist in modern training programs. Existing research has described the many challenges of technology adoption among agricultural producers, agriscience teachers, and students (Ertmer, 1999; Redmon et al., 2003; Smith et al., 2018). As new technologies emerge instructional methods must evolve to ensure career readiness for agriscience education students. Budin (1999) stated technology instruction should be reconceptualized regarding the specifics of how technology fits in the curriculum knowledge requirements for instructional delivery, and the assessment of technology instruction for students learning. Wood et al. (2005) identified five factors attributed to the hesitation of integrating and adopting technology in the secondary agriscience classroom: lack of support, restricted technical access, student application issues, technical problems, and teacher's attitudes and perceptions integrating technology in curricula. The benefits of incorporating technology in the secondary classroom have been studied extensively (Gorder, 2008) while Clemons et al. (2018) reported professional development in agricultural technology and STEM instruction was a continuing area of need for secondary teachers. Educational integration of precision agriculture and STEM applications in secondary agriculture classrooms benefit students through practical application and career preparation. Prior research indicated positive relationships between the use of STEM and agricultural classrooms. Smith et al. (2015) outlined the relationships between STEM and agriculture, noting that "agriculture teachers are confident in their ability to integrate science concepts…students who engage in math integrated agricultural power and technology class scored higher on a postsecondary math placement test" (p. 182-201). Many agriculture teachers unknowingly incorporate STEM into the existing agriscience education curricula . As agricultural technologies emerge, finding ways to incorporate precision agriculture topics that include STEM principles will not pose a challenge to teachers (Stubbs & Myers, 2016).

Although teacher self-efficacy regarding best pedagogical methods for STEM instruction could be an issue requiring enhance professional development. Many precision agriculture concepts already encompass science, technology, engineering, and mathematics. The combination of technology uses to solve specific problems are endless; engineering and mathematical components of precision agriculture technologies are necessary for the technology itself to function and can easily be investigated by students in a variety of settings and course topics. The flexibility of precision agriculture technologies across topics and educational structures is an enormous asset to teachers who choose to incorporate them into their coursework.

Conceptual Framework

Rogers' (2003) Diffusion of Innovation Theory is comprised of four components: innovation, communication channels, time, and social systems. The innovation element of Diffusion of Innovation Theory is composed of ideas that are considered new or emerging practices. Technology concepts are often innovative ideas and follow the Diffusion of Innovation Theory as people develop new ways to utilize technology.

Rogers (2003) discusses how homophily and heterophily affect the spread of ideas, stating that ideas flow more freely among homophilous individuals: individuals who are similar and work together towards mutual goals. Heterophilous individuals tend to be quite different from each other and therefore have a more difficult time communicating and agreeing on the importance of ideas and innovations. Time is considered by Rogers (2003) to be the measurement tool of the entire process of learning about innovations to adopting them. The innovation-decision process consists of an individual's course of learning over time that begins with learning of an innovation, learning about the innovation, forming an opinion on the innovation, and results in either adoption or rejection of the innovation (Rogers, 2003).

Social systems are the final component of Rogers' Diffusion of Innovation Theory. Social systems can be characterized as networks of individuals or units working together to accomplish a common goal, often groups of people or organizations. The leadership of some individuals or the normality of the group affect the flow of information and how it reaches individuals (Rogers, 2003). This element shares many characteristics with the idea of human capital, which describes how individual's professional and personal networks affect their decision-making process (Hunecke et al., 2017).

Rogers' Diffusion of Innovation Theory develops the process of innovation adoption and describes how groups of individuals within a social system can be identified based on the time it takes them to adopt innovations and the attributes that commonly affect their decision-making process. These categories are innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003). Innovators, individuals who are comfortable with uncertainty, are capable of higher-level thinking in regards to concept application. Early adopters are characterized as being slightly more contemplative than innovators and, are led by their opinions on the innovation and, evaluate the innovation subjectively. Individuals that comprise the early majority group rarely lead the way and are willing to adopt innovations. Early majority individuals often take longer than both innovators and early adopters to contemplate adoption of innovations and rely on their predecessor adopters for signs of success. Late majority adopters are cautious by nature and rely heavily on social norms to sway their decisions. They require little uncertainty surrounding the innovation in question. In comparison, laggards are the last group to adopt innovation. Laggards resist innovation adoption and often doubt the success of an innovation, exercising acute caution in the decision-making process.

The characteristics of innovation adopters described in Rogers' (2003) Diffusion of Innovation Theory are similar to attributes that influence decisions, intentions, and behaviors described in Fishbein and Ajzen's (1975) Theory of planned behavior. Fishbein and Ajzen (1975) stated that an "individual's intention to perform a behavior (behavior x) is influenced by their attitudes towards that behavior as well as their beliefs about the consequences of that behavior" (p. 16). Intention to perform a behavior (behavior x) is also influenced by subjective norms and normative beliefs about that behavior (Fishbein & Ajzen, 1975). The confluence of these theories considers behavior x to be the adoption of an innovation or idea.

Individuals are influenced by their attitudes and beliefs towards adopting new innovations (Fishbein & Ajzen, 1975). A similar example could be found with the opposite result, utilizing an innovator or early adopter as the instructor or individual. This individual's attitudes and beliefs towards adopting new ideas are positive, therefore they are more likely to incorporate precision agriculture technology into their coursework.

Purpose and Objectives

This study investigated agriscience teacher perceptions of curriculum involving precision agriculture technology and their insights regarding the integration of agricultural technology curriculum. The objectives of this study were: describe the courses and curriculum currently being used to teach precision agriculture concepts, describe the most important topics in precision agriculture and the relevance of precision agriculture in the areas of education and agriculture, describe potential relationships between participant personal characteristics and their incorporation of precision agriculture concepts in their classrooms, and describe the barriers that may prevent teaching precision agriculture.

Methods

The target population for this study were certified agriscience teachers in Alabama (N = 302) and Illinois (N = 391). Participants were identified using a contact data base provided by the professional agricultural education organizations in each state. Participants were randomly selected from each state using Cochran's (1977) theorem, Alabama (n = 169) and Illinois (n = 196) for appropriate sample size. Characteristics of the study participants included 60 male teachers (73.2%) and 22 female (26.8%) teachers with 69 (84.1%) indicating rural school location, 12 (14.6%) from suburban schools, and 1 (1.2%) from urban areas. Participants' teaching experienced ranged from 0-5 years (n = 22, 26.8%) 6-10 years (n = 21, 25.6%), 11-20 years (n = 16, 19.5%), 21-30 years (n = 18, 22) and greater than 30 years (n = 5, 6.1%). The final questionnaire was distributed to 373 participants with (n = 37) from Alabama and (n = 36) from Illinois yielding a 24.00 questionnaire response rate. Three attempts were made through email and two telephone conversations to increase the response rate. The total response rate was 88 completed questionnaires; however, 15 participants did not indicate their state. Non-response bias was addressed through oversampling 20% of the available population. Using Lindner et al. (2001) method 3 analysis and comparison of early versus late respondents was conducted using a t-test (Table 1) which did not identify any significant differences between timing and data results.

Table 1

Comparison of Early and Late Respondents

Statement	*t*	*df*	*Sig 2-tailed*
Relevance of Precision Ag in Agriculture Job Market	1.64	79	.11
Competence	1.49	86	.14
Relevance of Precision Ag in Coursework/Content	0.82	80	.42
Relevance of Precision Ag in Agriculture Industry	0.75	80	.45
Relevance of Precision Ag in Classroom Technology	.70	80	.48
Importance	.260	86	.80
Incorporation of Precision Agriculture	0.00	86	1.00

The review of existing literature did not identify an instrument appropriate for this study. Development of the questionnaire was completed by the researcher, two academic faculty in the agriscience education field, and an agriculture and natural resources extension agent. During the development of the instrument, fifteen preliminary research statements were selected to address participant perceptions of precision agriculture and potential barriers to incorporating precision topics and eighteen items to collect participant characteristics. Internal validity of the questionnaire was addressed by the instrument development team and eight individuals were selected to participate in a pilot test from (N = 4) from Alabama and (N = 4) from Illinois. Pilot study participants were representative of the population, but were not included in the sample of the population utilized for the study. The individuals selected to provide feedback in the pilot test were selected by the researcher based on their knowledge of research and their likeliness to provide honest and applicable analysis of the instrument. Pilot study participants were asked to review the instrument and provide input on the potential ambiguity of statements, sentence structure and other changes that may be necessary. Results from the pilot test indicated necessary changes to the instrument including ambiguity of specific statements and organization of the overall survey instrument. The analysis of data utilized descriptive statistics for describing the sample personal characteristics in each state. Borich's (1980) analysis was conducted to measure participants confidence and level of importance related to precision agriculture concepts and willingness to include precision agriculture in the curriculum. To further understand if a relationship existed between observed categorical values and theoretical expectations, a Chi Square for Goodness of Fit analysis was conducted.

Findings

Objective one sought to describe the courses and curriculum containing units or lessons pertaining to precision agriculture. Participants indicating their incorporation of precision agriculture were asked to identify courses they teach which contain units or lessons pertaining to precision agriculture (Table 2). The results indicated that 27 respondents (61.0%) incorporate precision agriculture concepts in introduction to agriculture, 16 (36.0%) in agribusiness courses, and *n* =13 (30.0%) incorporated precision agriculture in horticulture classes. Other courses were identified by respondents as agronomy, ag science, general agriculture, plant biology, ag sales and marketing, physical science applications in agriculture, crop and soil science, and advanced agriculture. Animal science and agricultural construction accounted for *n* = 8 (18.0%) respectively. Agricultural leadership courses, *n* = 5 (11.0%), forestry courses, *n* = 4 (9.0%), aquaculture courses, *n* = 2 (5.0%), and *n* = 11 (2.0%) in Cooperative Classes reported significantly less incidences of curriculum inclusion.

Table 2

Courses representing the inclusion of units or lessons pertaining to precision agriculture.

Courses in Agriscience Classrooms containing Precision Agriculture	*f*	%
Introduction to Agriculture	27	61
Agribusiness	16	36
Horticulture	13	30
Ag Mechanics	13	30
Other	13	30
Animal Science	8	18
Ag Construction	8	18
Agricultural Leadership	5	11
Forestry	4	9
Aquaculture	2	5
Cooperative Class	1	2

Participants were organized according to their incorporation of precision agriculture instructional materials within existing curricula (Table 3). The greatest number of participants (*n* = 26, 59.0%) indicated self-created curriculum materials were used for the instruction of high school agriscience teachers. Online resources (*n* = 23, 52.0%), hands on technology (*n* = 20, 45.0%), textbook (*n* = 14, 32.0%), purchased/packaged curriculum (*n* = 10, 22.0%), and "other" (*n* =3, 6.0%) were indicated as resources. The use of simulators (*n* = 2, 4.0%) was the least used type of instructional materials.

Table 3

Curriculum Resources Most Often Utilized In Precision Agriculture Instruction

	Resources most commonly used	
Resources	*f*	%
Self-created curriculum	26	59.0
Online resources	23	52.0
Hands on technology	20	45.0
Textbook	14	32.0

Purchased/packaged curriculum	10	22.0
Other	3	6.0
Simulators	2	4.0

Participants indicated their perceptions related to the future of precision agriculture instruction. Participants were provided four statements (Table 4) pertaining to education in their classroom or in agriculture and indicated their opinion of relevance 5-10 years in the future on a scale from 5, extremely relevant, 4, somewhat relevant, 3, no change in relevance from today, 2, somewhat irrelevant, and 1, extremely irrelevant. Participants perceptions of future instruction in precision agriculture were overwhelmingly relevant for future employment opportunities for students. In their classroom technologies, 96% of teachers indicated that precision agriculture topics were either extremely relevant or somewhat relevant. Teacher perceptions of the most important topics involving precision agriculture were analyzed depending on their incorporation of precision agriculture concepts in their classrooms. Teachers who indicated their incorporation of precision agriculture in their classrooms identified the most important topics as 20.9% (GPS), 20.9% (soil sampling or land management), 14.0% (variable rate technology), 9.3% (yield monitoring), 4.7% (automated production Systems), 4.7% (unmanned aerial systems or vehicles), 23.3% (genetic modification), 2.3% (chemical technology), and 0% (Satellite Imaging).

Table 4

Topics of Secondary Agriscience Instructional Importance in Precision Agriculture

Topics of Importance	Incorporate Concepts		Do Not Incorporate Concepts	
	f	%	*f*	%
Global Positioning Systems	9	20.9	11	28.9
Genetic Modification	10	23.3	8	21.1
Soil Sampling/Land Management	9	20.9	7	18.4
Variable Rate Technology	6	14.0	4	10.5
Yield Monitoring	4	9.3	2	5.3
Automated Production Systems	2	4.7	2	5.3
Unmanned Aerial Systems/Vehicles	2	4.7	2	5.3
Satellite Imaging	0	0	2	5.3
Chemical Technology	1	2.3	0	0
Other	0	0	0	0
Total	43	100	38	100

Teachers indicating no inclusion of precision agriculture concepts in their classrooms identified the most important topics (Table 5) in precision agriculture as: 28.9% (GPS), 21.1 % (genetic modification), 18.4 % (soil sampling or land management), 10.5 % (variable rate technology), 5.3 % (satellite imaging), 5.3 % (yield monitoring), 5.3 % (automated production systems), 5.3 % (unmanned aerial systems or vehicles). Participants not currently teaching precision agriculture reported chemical technology as not important for instruction.

Table 5

Participants Perceptions of Future Relevance of Precision Agriculture Topics

	Extremely Relevant		Somewhat Relevant		No Change in Relevancy		Somewhat Irrelevant		Extremely Irrelevant	
Areas of Relevance	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Agriculture Industry	72	88	10	12	0	0	0	0	0	0
Agriculture Employment	61	75	20	25	0	0	0	0	0	0
In Classroom Technologies	46	56	33	40	3	4	0	0	0	0
Coursework/Content	35	43	43	52	4	5	0	0	0	0

A chi-square goodness of fit test was used to identify the potential for relationships that may exist between the participants' personal characteristics and their decision to incorporate precision agriculture concepts into their curricula (Table 6). A significant relationship would signify that a personal characteristic would have an effect on their decision to incorporate precision agriculture. The results of this objective did not identify any significant relationships between participant personal characteristics and their decision to incorporate precision agriculture concepts into their curricula.

Table 6

Contingency Table by Personal Characteristics and Incorporation of Precision Agriculture Topics

Personal characteristics	*n*	*df*	*Sig*
Age	80	4	.91
Years teaching	82	4	.87
Gender	82	1	.79
State	73	1	.72
Education level	82	2	.42
School location	82	2	.34
Student enrollment	81	2	.13

Conclusions, Implications, and Recommendations

Agriculture teachers indicated limited integration (50.0%) of precision agriculture instruction within their existing curriculum. This finding supports Rogers (2003) findings that individuals will adopt innovative approaches in a timely manner, while others may resist implementation because of doubt related to the potential for success of the innovation. Participants (50%) in this study reported their interest in curricula integration would best be described as innovators; those demonstrating higher order thinking in relation to adoption of concepts to application. Participants indicating the incorporation of precision agriculture concepts occurred in traditional secondary agriscience courses: introduction to agriculture, agribusiness, ag mechanics, and horticulture. In comparison, participants identified potential barriers to integration: funding, equipment, curriculum, experience, and professional development. These findings support the barriers of technology reported by Wood et al. (2005).

The participants indicated their most important topics in precision agriculture as GPS, soil sampling/land management, and genetic modification. Teachers also described the resources they use as their curricula, resulting in the most common resources being self-created curriculum (59%), online resources (52%), and hands-on technology (45%). When asked about their perception of the future relevance of precision agriculture in their classrooms and in their coursework, participants indicated extremely relevant, somewhat relevant or "no change in relevance from today. Fishbein and Ajzen (1975) postulated the means in which individuals' intention to perform a behavior is influenced by their attitudes towards the consequences of the behavior. The conclusions of this study support the theory of planned behavior at the various levels of integrating precision agriculture related curricula. When asked the relevance of precision agriculture topics in the agriculture industry and in the agriculture job market, participants reported precision agriculture being extremely relevant or somewhat relevant in 5-10 years. Participant support coupled with forecasting future trends in agricultural employment arenas tended to be positive. Participants perceived value in precision agriculture curricula while respecting the role this content will have in their student's future employment.

Participants identified the most important lessons for integrating precision agriculture curriculum regardless of their decision to incorporate precision agriculture into their curricula: GPS, Soil Sampling/Land Management, and Genetic Modification. Participants were asked to indicate the relevance of precision agriculture 5-10 years in the future in four areas: (in your classroom, in your coursework/content), 61.0% indicated their perception of precision agriculture as "extremely relevant" while 39.0%indicated precision agriculture being either "somewhat relevant" in the future or "no change in relevance from today. Participants overwhelmingly agreed (75.0%) that precision agriculture will be valued in the agriculture industry and in the agriculture job market while 25.0% indicated precision agriculture being somewhat relevant 5-10 years in the future. Participants indicating hesitation to the level of relevance may be reflective of Wood et al. (2005) suggesting factors associated with technology integration in agricultural education programs.

It is recommended that further research focusing on precision agriculture in agriculture education be conducted. This recommendation supports the findings of Glenn (1997) by advocating for public support related to technology instruction in public school systems. As the agriculture industry grows and advances, so should agriculture education and research efforts. The identification of possible content areas or educational concepts to better prepare students entering careers in precision agriculture, should be investigated and include individuals currently pursuing careers in precision agriculture. By comparing the education patterns of those who currently hold careers in precision agriculture, preparatory education could become more specific and therefore more beneficial to those wishing to enter a career in precision agriculture.

A need exists for professional development and teacher education focusing on precision agriculture and was supported by Palak and Walls (2009). Future studies should identify specific areas within precision agriculture that would be most beneficial to teachers and, in turn, their students. This recommendation may be limited by what (Ertmer, 1999; Redmon et al., 2003; Smith et al., 2018) reported as challenges associated with technology adoption among agriculturalists. A compilation of resources for teachers to use in building curriculum is needed. Reliable information that is accurate and representative of what occurs in the agriculture industry should be gathered and presented to teachers for use in their classrooms and should be updated annually to best reflect the technologies used in the agriculture industry. Similarly, partnerships between agriculture education and the companies that specialize in precision agriculture technologies should be formed so that teachers are equipped with the tools needed to educate their students. These industry partners are imperative to keeping secondary agriculture education relevant and sparking the interest of students to work in the agriculture industry.

Precision agriculture is a progressive and emerging topic in agriculture that is facing farmers with the decision to either move with the flow of technology or get left behind. Many people within agriculture, let alone outside the field, do not understand precision agriculture or what it entails. This leads to confusion, misinformation and general misconceptions surrounding the topic of precision agriculture, which underlines the importance of familiarizing future agriculturalists with the precision-rich agricultural future they are to inherit. Precision agriculture can be identified in various arenas: innovative technology development and the application of technology in real life. We, as agricultural educators, must do our part in educating agriculturalists on the best practices for applying this emerging technology to its respective goal. Secondary agriculture educators work with students who live in this agriculturally rich world every day, they are our connection to the future of agriculture. By incorporating precision agriculture technologies that are already being used in agriculture, students will be better prepared.

Teaching students to care for the environment is becoming prevalent in secondary agricultural education curriculum and precision agriculture content would be the next evolutionary step. Environmental science and stewardship practices define a component of production agriculture education and the inclusion of concepts which provide data based and technological components reinforce environmental science curriculum. The implications of combining precision agriculture and environmental science will aid in the development of students STEM processes and the ability to implement STEM practices in a meaningful and productive manner. Continuing education for practicing agricultural education teachers should contain concepts and instruction in precision agriculture. Professional development opportunities would allow teachers to become more comfortable with the content and in the development of standalone modules or incorporation of precision agriculture concepts within existing curriculum. Agricultural education teachers should be provided pre-service training through Colleges of Agriculture or preparatory work in Colleges of Education as familiarity with the content would reduce anxiety and doubt for younger teachers and give direction to veteran teachers looking to update their course materials.

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Teaching Agriculture-specific Controversial Issues Through Guided Group Discussion

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Research Type: Mixed Methods
Research Priority Area: Teaching and learning in undergraduate academic programs

Teaching Agriculture-specific Controversial Issues Through Guided Group Discussion

Abstract

The effect of participating in and observing a guided group discussion on attitude toward agriculture-specific controversial issues was investigated. Fifty-five undergraduate students over two semesters completed a pretest to measure attitudes toward two controversial topics: sustainable agriculture and animal welfare. After the pretest, students were randomly assigned to one of four roles. Each role was assigned one of the two topics and given neutral questions to research in preparation for a group discussion that were related to the characteristics of controversy. Two roles, each with a different topic, met for the purpose of having neutral discussions on the topic. While one group discussed, the other group observed. A posttest was administered to measure the change in attitudes toward the controversial topics. Students also provided written responses to open-ended questions regarding their experience with the group discussion activity. No significant differences between pretest and posttest scores were observed. Based on the qualitative data, students preferred teacher centered methods of teaching controversial issues and appreciated that the guided group discussion approach allowed controversial topics to be considered and delivered objectively.

Keywords: controversial issues, group discussion, animal welfare, sustainable agriculture

Introduction

Many controversial issues are closely related to agriculture, such as genetically modified organisms, food product labeling, or animal identification systems. Consequently, much of these issues become infused into agricultural education curricula, often presenting ideas that conflict with the values of students (Cotton, 2006b). Though controversial topics in agricultural science classrooms have become a larger issue in recent years given that political parties have become enamored with debating climate change and other agricultural related topics (Owens et al., 2017), the research on teaching agriculture-specific controversial issues is severely limited (Agbaje et al., 2001; Bennett-Wimbush et al., 2015; Fiske, 1991; Goodwin, 1993; Nordstrom et al., 2000; Poole et al., 2016; Terry & Lawver, 1995). Whether educators can maintain neutrality when teaching controversial issues is questionable, as the rhetorical nature of controversial issues suggests that teacher neutrality may be impractical and "the idea of maintaining a neutral position is portrayed as an illusion" (Cotton, 2006a, p. 77). The inability to maintain neutrality begs the question, why teach controversial issues?

Teaching about issues that are controversial, while requiring a lot of time and preparation, has been viewed as a useful tool for preparing students to become effective citizens (Soley, 1995). A healthy democracy is based on the nature of open discussion about issues of public concern. Therefore, young citizens should be trained in the discussion of social, political, and economic policies that are controversial (Harwood & Hahn, 1990). Additionally, introducing controversial issues serves as an appropriate way for students to learn about values and value conflicts. Another advantage of instruction on controversial issues is the encouragement of thinking. Assessment that measures students' ability to regurgitate facts requires low levels of thinking; however, learning about controversial issues requires in-depth study, consideration of facts versus opinions, and critical examination of the issues. Learning how to approach, investigate, and form an opinion on controversial issues may present cognitive conflict, but can also serve as a bridge for assisting students in dealing with their own personal conflicts (Soley, 1995). Though the benefits of teaching controversial issues present a strong argument in support of the notion, teacher attitudes and perceptions should be considered.

While many educators believe that teaching controversial issues is important, this belief system is only in place so long as the teaching of these issues does not endanger their careers (Byford, Lennon, & Russel, 2009). Support from educators exists because teaching controversial topics exposes issues of personal and societal interest that students can often relate to, but some teachers are unsure of their ability to teach controversial content (Byford et al., 2009; Zimmerman & Roberston, 2017). Asimeng-Boahene (2007) asserted that "conducting beneficial discussions on controversial issues is an art that requires skills and practice" (p. 235). To increase teacher efficacy for presenting controversial issues, training is needed that focuses on the nature of controversial issues, principles for teaching controversial issues, and effective teaching strategies (Robertson, 2018), especially when topics are polarizing.

Zimmerman and Robertson (2017) explain that controversial issues fall into three categories: expert-expert disagreement, expert-public disagreement, and maximally controversial issues. Expert-expert disagreement is characterized by experts disagreeing on topics not of widespread public concern (such as interpretations of literary works or visual art), whereas expert-public disagreement is described as experts agreeing, but members of the general public contesting the stance of experts (such as climate change being caused by human behavior). Maximally controversial issues are those where experts disagree with each other and members of the general public disagree with each other, the topic is of public concern, and discussions generate an emotional response (such as abortion, voting rights, or same-sex marriage). In agricultural education, animal rights (Nordstrom et al., 2000) and sustainable agriculture (Agbaje et al., 2001) are examples of maximally controversial issues that can be so dividing, teachers must exercise caution when teaching them, but how?

When introducing controversial issues, adopting a stance that is non-committal and neutral is critical (Asimeng-Boahene, 2004; Zimmerman & Robertson, 2017) because "everything the teacher does, as well as the manner in which he does it, incites the child to respond in some way or another, and each response tends to get the child's attitude in some way or the other" (Dewey, 1933, p. 59). Teachers should not be afraid to share their opinions with a class; however, they need to be able to defend their opinions with logical explanations and should emphasize that their position is one of many and that it may be challenged. Still, agriculture, as a content area, is unique in that student attitudes may be strongly rooted and influenced by personal background. For example, Terry and Lawver (1995) discovered that male students had more positive perceptions about using medications on animals that females and that hometown background such as growing up on a farm or living in a town of less than 5,000, for example, explained large amounts of variance in student perceptions of issues related to agriculture. Further, Poole et al. (2016) discovered academic major influenced student concerns about agricultural issues, and Bennett-Wimbush et al. (2015) reported female students were better able to distinguish between animal rights and animal welfare than male students. Therefore, agricultural educators may be more inclined to employ a strategy that affords ambiguity of personal stance when teaching. One method of introducing controversial issues into the classroom, alleviating the teacher from committing to one side or the other, is group discussion (Ho et al., 2017).

Through group discussion, students can expand their clarity of controversial issues. In addition to serving as a bias free approach, group discussions on topics that are controversial in nature are stimulating and "can be an excellent way of expanding the knowledge students have about the changing world in which we live" (Asimeng-Boahene, 2004, p. 233). According to Hess (2009), discussion is a valued form of learning for students. After selecting an issue to be discussed, teachers must prepare students for the discussion, provide an adequate amount of information resources, ensure an intellectual balance, and encourage equal participation. Because there are typically not right or wrong answers with controversial issues, performance-based activities, such as group discussions, are often better suited for assessment than traditional paper-based tests. Performance based activities allow educators to assess a student's ability to evaluate competing arguments, use evidence to defend a position, and draw well thought out conclusions (Asimeng-Boahene, 2004). Furthermore, participation in group discussion demonstrates performance at higher levels of learning (Anderson et al., 2001), but not all educators agree with discussion as the best technique. Proponents of teacher centered classrooms argue that teaching only the facts or concepts is easier and more straightforward than helping students examine attitudes, values, and beliefs associated with controversial issues; however, if students do not learn to address moral dilemmas and argue social issues when in school, when will they? Teachers have the responsibility of supplying a format for learning how to identify controversy and labor through it (Asimeng-Boahene, 2004; Zimmerman & Robertson, 2017).

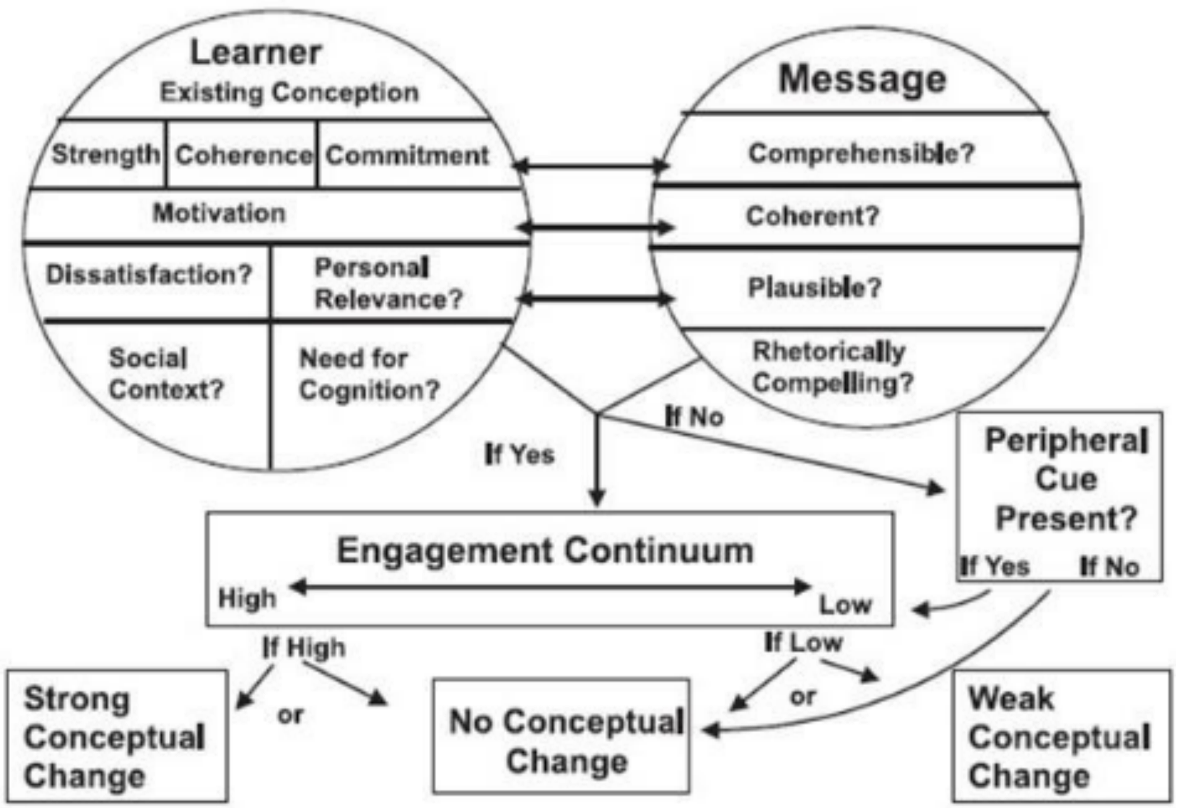
Theoretical and Conceptual Framework

The framework for this study was built on Festinger's (1957) cognitive dissonance theory and the cognitive reconstruction of knowledge model (CRKM) (Figure 1) presented by Dole and Sinatra (1998). According to Festinger (1957), people desire consistency among individual concepts including attitudes, behaviors, beliefs, values, and opinions. Cognitive dissonance theory purports dissonance occurs when information is presented that contradicts with one's held concepts. The strength of dissonance is impacted by two things – the amount of discordant beliefs and the degree of importance attached to each belief. When contradiction is present, something must adjust to eliminate the dissonance. Festinger's theory provides three methods by which dissonance can be removed. One possibility for eliminating dissonance is the reduction of importance of the inharmonious thought. A second option for removal involves attaching more harmonious beliefs that compensate for the dissonant beliefs. The third method for removing dissonance is to change the cacophonous beliefs so that they are no longer inconsistent (Festinger, 1957). When beliefs are altered to rid inconsistency, conceptual change occurs. Conceptual change refers to "revisions in personal mental representations; revisions that are often precipitated by purposeful educational experiences" (Murphy & Mason, 2006, p. 307). Because group discussions about controversial topics will facilitate cognitive dissonance, conceptual change may occur.

In comparison to cognitive dissonance theory, the CRKM considers cognitive psychological research, science education research, and social psychology (Dole & Sinatra, 1998). This model provides a description of the interactions between learner and message characteristics, which lead to various degrees of engagement with a new concept. The likelihood that conceptual change will occur depends on the depth of engagement – significant conceptual change is more likely when learners present high engagement on the engagement continuum.

Figure 1

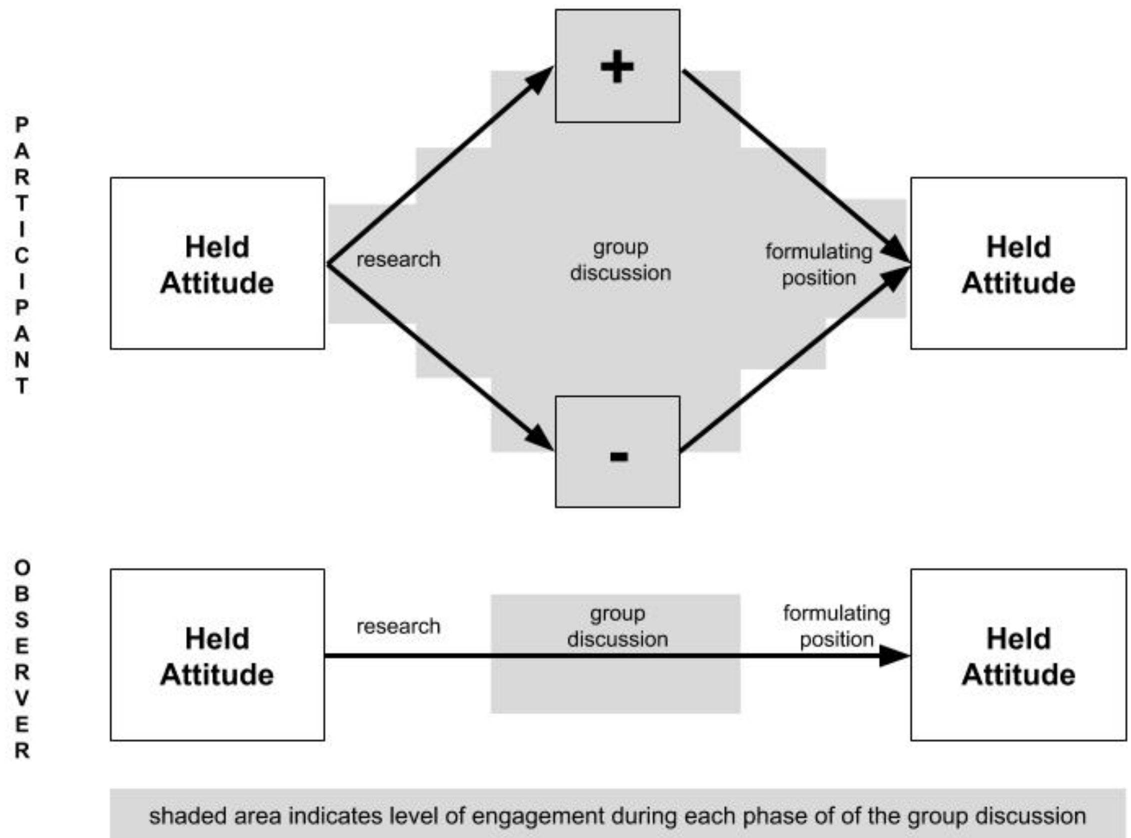
Cognitive Reconstruction of Knowledge Model (Dole & Sinatra, 1998)



The visual model (Figure 2) developed by the researchers provides the conceptual framework for the present study. In the model, engagement levels of two groups, participant and observer, are depicted by shaded areas at each phase of a group discussion guided by research questions. Participants are those who are involved with researching a topic, discussing the topic from a neutral stance, and formulating a position on the topic after the discussion. Observers are those who watch and listen, but have no formal responsibilities before, during, or after the discussion. Being active in each phase, the researchers assume participant group engagement will start low during the research phase, reach a crescendo during the group discussion, and decrease again in the final phase when participants are formulating a final position. With a passive role, the researchers assume the observer group will not be engaged during the research or formulating position phases and experience limited engagement during the group discussion. Each engagement continuum is bookended by held attitudes about topics being discussed, as students will hold a perspective before and after the discussion.

Figure 2

Visual Model of the Conceptual Framework



Purpose and Research Questions

The purpose of this study was to investigate the utility of guided group discussion (Lewin, 1952; Werner et al., 2008; Werner & Stanley, 2011) as a method for providing instruction on controversial issues. When a teacher presents information on topics that are controversial in nature, there may be students who disagree with the content, resulting in cognitive dissonance. With continued instruction, conceptual change could occur; however, if the teacher is unable to instruct in a neutral manner, he or she may unintentionally cause conceptual change from a bias standpoint. The study was steered by the overarching question of whether guided group discussion was an effective approach to teaching controversial issues. Specific questions were:

1. What is the effect of participating in a group discussion on attitudes toward controversial issues?
2. What is the effect of observing a group discussion on attitudes toward controversial issues?

3. How do students prefer to learn about controversial issues?
4. How do students perceive the strategy of guided group discussion for learning about controversial issues?

Methods

The participants in this study were undergraduate students enrolled in a fall semester and spring semester agricultural oral communications course at a four-year university in the southeastern region of the United States. The course was a required course for all students pursuing an undergraduate degree in an agricultural field. Data were collected over two semesters resulting in a total of 55 students divided across five laboratory sections over the two semesters. Institutional Review Board procedures were followed by university guidelines. Consent was obtained from all participants. Table 1 provides a description of the participants.

Table 1

Description of Participants (N= 55).

Variable	*n*	%
Sex		
Female	29	52.73
Male	26	47.27
Age		
18–22	47	85.45
23–27	6	10.91
28–32	2	3.64

Instruments were used in a pretest and posttest to assess the attitudes of students toward two specific controversial issues – sustainable agriculture and animal welfare. Sustainable agriculture is the production of plant and animal products for human consumption through methods that are ecologically sound and socially responsible as well as economically viable (Ikerd, 2008, p. 11). As this method of production contradicts modern industrial agriculture techniques, agricultural education teachers are unsure about the potential for sustainable agriculture to enhance the quality of life for famers and society, thus making this topic controversial in the agriculture industry (Agbaje et al., 2001). According to Broom (1991), animal welfare refers to the state of an animal in relation to its environment, with welfare being a characteristic of an animal, not something given to it; indicators of poor welfare may include reduced life expectancy, impaired growth, body damage, and adrenal activity, among others. Attitudes regarding appropriate treatment of animals differ greatly with polarized opinions related to hunting, production and consumption of animals for food, and using animals in biomedical and psychological research (Herzog & Mathews, 1997); therefore, this topic is also controversial in the agriculture industry.

The Sustainable Agriculture Attitude Test was an adapted version of a test, developed by Allahyari et al. (2008), comprised of twelve self-report items on a five-point Likert-type scale. A response of “1” to each item indicated strong disagreement and a response of “5” indicated strong agreement. Sample items included “The primary goal of farmers should be to maximize the productivity, efficiency, and profitability of their farms” and “The key to agriculture’s future success lies in learning to imitate natural ecosystems and farm in harmony with nature”. Total scores on this instrument can range from 12 to 60; higher scores suggested positive perceptions toward sustainable agriculture. The calculated Chronbach’s alpha reliability coefficient for the pretest and posttest was 0.69 and 0.60, respectively, demonstrating low, but acceptable levels for this type of exploratory research (Murphy & Davidshofer, 1988).

The Animal Attitude Scale, developed by Herzog et al. (1991), measured attitude towards animal welfare and was comprised of 20 self-report items on a five-point Likert-type scale. A response of “1” to each item indicated strong disagreement and a response of “5” indicated strong agreement. Sample items included “I think it is perfectly acceptable for cattle and hogs to be raised for human consumption” and “Much of the scientific research done with animals is unnecessary and cruel”. Total scores on this instrument can range from 20 to 100; higher scores suggested greater levels of concern for animals. The calculated Chronbach’s alpha reliability coefficient for the pretest was 0.90 and the Chronbach’s alpha reliability coefficient for the posttest was 0.90 as well.

One month after completing both pretests, students within laboratory sections were randomly assigned to two groups for the purpose of participating in a group discussion. Each role was then randomly assigned a controversial topic for the group discussion – sustainable agriculture or animal welfare. Students in each group received a set of neutral, topic specific guiding questions that focused on the characteristics of the controversy and were instructed to answer these questions, individually, in preparation for a group discussion. Two weeks after receiving the research questions, students participated in a 20-minute group discussion guided by the questions researched. Prior to the discussion, students were instructed to maintain a neutral position and present evidence gathered during individual research, while addressing both sides of the controversy. As the discussion took place, participating students took notes on various points that were made. At the conclusion of the discussion, each student formulated a position on the topic and articulated this position in a closing statement. While one group in each laboratory section participated in the discussion, the other group observed. Two weeks after the group discussion, the same instruments were used in a posttest. Additionally, students in the spring semester provided written responses to eight open-ended questions regarding their experience with the group discussion activity. According to Bogdan and Biklen (2003), participants will express opinions more freely with open-ended questions.

This mixed methods study was designed as an embedded sequential explanatory case study with a quantitative→qualitative two-strand design of inquiry (Creswell et al., 2003). The first strand of inquiry used a quantitative approach to explore student attitudes toward agriculture-specific controversial issues. The second strand of inquiry qualitatively investigated how students experienced the group discussion.

To answer research questions one and two, attitude pretest and posttest scores of the two roles (participant or observer) by topic and semester were analyzed using a paired samples *t*-test. This is an appropriate analysis to compare the difference between the means in cases where the same participants respond on two separate incidents (Howell, 2007).

Research questions three and four, which were qualitative in nature, were answered using a constant comparative analysis approach to interpret responses to the open-ended questions. According to Glauser and Strauss (1967), this approach requires identifying similarities and differences in content through a systematic review of data. As the researchers coded the responses separately, inter-rater reliability was established, which increased the confidence in emergent patterns (Bernard & Ryan, 2010). Participant quotes were used to support research findings. Because critics may be reluctant to accept the findings from qualitative research, the researchers applied Guba's (1981) framework for assessing the trustworthiness of qualitative inquiries. In the present study, the researcher ensured credibility by developing a familiarity with the culture being investigated, using a mixed methods approach for triangulation of data, and conducting member checks by sharing selected quotes associated with conclusions drawn with students who provided the quotes. Transferability was ensured as the researchers described the context of the study and described the phenomenon under investigation. Finally, confirmability was achieved by admitting researcher beliefs and assumptions in regard to the study and identifying limitations of the study.

Findings

The researchers were concerned with looking at data collected from each of the roles for the two topics. Each discussion group was comprised of undergraduate agricultural majors, but heterogeneous in gender, age, and ethnicity. For each topic, there were five groups who participated in a guided group discussion and five groups who observed (Tables 2 and 3).

Table 2

Participant Role Test Scores (N= 55)

	Pretest				Posttest			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Sustainable Agriculture	39.07	4.27	31	47	38.29	4.14	31	46
Animal Welfare	64.54	14.08	37	85	64.27	13.73	34	89

Note. Scores on the Sustainable Agriculture Attitude Test range from 12 to 60. Scores on the Animal Attitude Scale range from 20 to 100.

The mean score on the pretest for those who participated in a discussion about sustainable agriculture was 39.07 (*SD*= 4.27). For those who observed a discussion about sustainable agriculture, the mean score on the pretest was 41.64 (*SD*= 4.48). On the posttest, for those who participated in the discussion, the mean score was 38.29 (*SD*= 4.14), while the mean score for those who observed was 40.44 (*SD*= 4.03).

Table 3

Observer Role Test Scores (N= 55)

	Pretest				Posttest			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Sustainable Agriculture	41.64	4.48	32	49	40.44	4.03	34	47
Animal Welfare	65.00	10.45	40	84	65.64	9.68	41	82

Note. Scores on the Sustainable Agriculture Attitude Test range from 12 to 60. Scores on the Animal Attitude Scale range from 20 to 100.

The mean score on the pretest for those who participated in a discussion about animal welfare was 64.54 (*SD*= 14.08). For those who observed a discussion about animal welfare, the mean score on the pretest was 65.00 (*SD*= 10.45). On the posttest, for those who participated in the discussion, the mean score was 64.27 (*SD*= 13.73), while the mean score for those who observed was 65.64 (*SD*= 9.68).

Research question one inquired about the effect of participating in a group discussion on attitudes toward controversial issues. The results of a paired samples *t*-test indicated that the effect of participating in a group discussion was not statistically significant.

Research question two asked about the effect of observing a group discussion on attitude toward controversial issues. The results of a paired samples *t*-test indicated that the effect of observing a group discussion was not statistically significant.

Research question three explored how students preferred to learn about controversial issues. The open-ended questions prompted students to reflect on prior experiences with controversial issues in a classroom setting and explain how they preferred teachers to present topics that are controversial in nature. Student responses indicated a variety of experience with methods that encouraged active learning such as debates, research papers, and general classroom discussions. Passive learning experiences were described as lecture or illustrated lecture (where a PowerPoint presentation was used). Students were not favorable of methods that only presented one side of an issue, evidenced by comments such as “I have had teachers only present their biased opinions and I didn't like that at all. Teaching that way doesn't give the student the opportunity to see both sides and make a decision on where the student stands.” and “Just listening to a lecturer can cause the audience to take on the lecturer's opinion.” Interestingly, when asked about how the students enjoyed learning about controversial topics, the students indicated a preference toward passive learning experiences. Students commented, “I prefer teachers present controversial topics by providing an objective lecture supported with a PowerPoint. I think it is important to introduce the controversial topic and let the audience form their own opinion of the subject.” and “I would prefer a completely unbiased presentation of both sides, probably in a list of facts such as on a PowerPoint or in a lecture; but as long as neither view point is pushed on me.” The preference for an objective, teacher centered approach is consistent with cognitive dissonance theory (Festinger, 1957), which asserts people crave information to be presented in a way that does not conflict with personal convictions. A non-persuasive lecture void of discussion allows students to diminish the importance of dissonant information.

Research question four addressed how students perceived the strategy of guided group discussion for learning about controversial issues. The general impression was that students enjoyed the learning environment created by the requirement of maintaining neutrality. Most enjoyable was the objectivity and evidence-based component of the discussion:

> The thing I enjoyed most was being able to have a comfortable conversation with classmates without being at each other's throats over some controversial issues. I didn't grow up on a farm, nor do I have strong opinions on sustainable agriculture, but I could tell some people in the class did, so if we had more of a debate, I would expect there to have been much more conflict.

Another participant responded:

> I liked the fact that it was objective and not just people spewing out their opinions. Everything had to be backed up with evidence, which should always be the case, but often times aren't in debate or other opinionated discussion.

While students appreciated the nonthreatening environment, maintaining a neutral position proved to be a challenging aspect of the guided group discussion. Students reported that the inability to state their own opinions, and the domination of conversation by other students was frustrating:

> It was difficult to stay neutral and it was hard to verbalize negative aspects of sustainable agriculture because there were not many negatives found during researching the topic. I found it frustrating to not be able to clearly state your side.

One participant commented, "It was difficult to be neutral on the topic of animal welfare. I also didn't like how I had a hard time butting in to talk when three people in my group dominated the conversation." In spite of these frustrations, students agreed that the teaching strategy was beneficial. Requiring students to research the topic before the discussion and providing questions to guide their research efforts helped engage students in the learning process. One participant wrote, "I still feel the same way about the topic, however I have gained a greater appreciation for sustainable agriculture. I feel quite strongly against sustainable agriculture, however after learning more, I did appreciate it more." Another participant commented:

> I certainly felt that the research was the most informative part of this assignment. I put a lot of time into the research so that I could fully understand both sides of each of the questions posed. The guiding questions were very good because they covered a wide range of animal welfare issues and required that we explore each of the aspects, including those that we may not have considered on our own.

A student concluded, "It really made me see both sides and look at the topic open minded." From an observation standpoint, students commented that watching their classmates engage in the discussion was educational, exposing different viewpoints. The role of observer also made students aware of how telling facial expressions and body language can be in a group discussion. While they enjoyed observing, students often found this role difficult, expressing a desire to join the conversation. According to one student, "I really wanted to jump in to the discussion when we listened to the other group." Interestingly, observing students noticed when those discussing the topic held a certain opinion based on their nonverbal communication - "It was very clear when some people disagreed with what was said because of their facial expression and body language." Observing the participation also had the benefit of exposing students to unknown knowledge: "When observing the other group's discussion, I was surprised at the facts and figures the group gave. I had no idea about the topic and the concrete evidence was very clarifying." Students valued the factual evidence that was presented during the discussion. One observing participant reported, “I thought that observing another group was very beneficial to me because I was able to gather a lot of unbiased information on the topic and was able to create my own unbiased view on their topic.”

Conclusions, Implications, and Recommendations

Guided group discussion is characterized by an instructor identifying a controversial topic, creating questions to guide students through investigating all aspects of the topic before a discussion, and designing a structure for group discussion that requires participants to speak from the supporting and opposing side of a topic while asking questions of other participants. The guided group discussion technique may help teachers feel comfortable facilitating the learning about controversial topics, as this approach removes instructors from the possibility of impacting conceptual change due to not maintaining a neutral position. Participating in a guided group discussion about controversial issues has many implications in support of this instructional method as an approach to cognitive dissonance and conceptual change. First, participating in and observing a guided group discussion encourages students to consider both sides of an issue which might not occur in a lecture format. The action of researching both sides of an issue encourages student learning at higher levels of Bloom’s Taxonomy (Anderson et al., 2001), where examining data, organizing ideas, and preparing for a discussion require analyzing ideas and evaluating positions. The highest level of Bloom’s Taxonomy, creation, is reached when students compare the different points of discussion, evaluate the information, and then construct their own position when presenting a closing statement where an argument toward the controversy is presented and supported by garnered knowledge. Secondly, guided group discussion allows the teacher to maintain neutrality and avoid bias when providing instruction on controversial issues, which Cotton (2006a) explained is unfeasible. This frees the teacher from struggling to not employ a personal agenda and creates an autonomous learning environment for the students, which gives way to a third advantage of guided group discussion – teacher protection from responsibility of conceptual change. The CRKM (Dole & Sinatra, 1998) suggests that conceptual change is unlikely with low engagement; however, the possibility of conceptual change increases when engagement is high. As the guided group discussion technique accelerates high engagement for students participating in the discussion, conceptual change is possible. In the present study, if conceptual change had occurred, students would have been responsible for their individual conceptual change, not the instructor, concluding that guided group discussion as an instructional approach to controversial issues relieves the teacher from responsibility of conceptual change that may occur amongst students.

While the data did not show a significant difference between the effects of participating in or observing a group discussion on attitude toward controversial issues, further research with additional groups of varying sizes, populations, and topics is recommended. In addition, we recommend that modifications be made in future studies to provide for the collection of evidence that each student conducted background research prior to the discussion. Evidence could be in the form of written responses to the guiding questions, an outline that explains key findings during research, or a conceptual model designed by students that highlights information discovered, for example. Another recommendation is the provision of equitable talk time amongst participants. During the group discussions, some students dominated the conversation while others were more passive in their participation. Brookfield and Preskill (1999) posit that participation in discussion will help students develop a more critical understanding of and appreciation for diverse viewpoints; therefore, ensuring equal participation by each student in the discussion is critical for maximum benefit of the small group discussion. Additionally, equitable treatment, regarding amount of time spent discussing the various characteristics of controversy, is encouraged. Early in the discussions, students spent much of the allotted time focusing on a few specific areas of controversy, resulting in less time for discussing additional aspects. Not providing time for discussing the topics from multiple angles and viewpoints may limit students in their ability to form an opinion on the issue. Students who participated in the discussion recommended more preparation before the activity occurs. One student remarked, “I really don't have any more recommendations, other then maybe explaining how it’s done a little more in depth then what we covered in class.” Another student indicated:

> Since this was our first discussion I would have liked to do a dry run and gone over what things were going to be said and get a feel on what things impacted the memebers the most. I am not quick at thinking off the top of my head and I felt like that was a huge drawback for me with this exercise and I feel like I really didn’t do a good job on the task at all.

We acknowledge limitations of this study related to the population and sampling. Findings are limited to the case site under investigation and cannot, therefore, be generalized to a larger population. This limitation could not be overcome using the chosen method because data collection required adapting course syllabi and curricula, and therefore, other case sites willing to accommodate such required adaptations were not identified. Also, the student sample for the qualitative data collection only represented perspectives from students in the spring semester. It is possible that perspectives of students from the fall semester could differ; however, because the course is required for all students pursuing an undergraduate degree in an agricultural field at the university where the research took place, we determined the sample was representative of the total population under investigation.

In future studies, we recommend that discussions be recorded, transcribed, and analyzed for the frequency of statements in support of or opposition to a topic, as this might have an impact on posttest scores. This type of analysis would identify possible inequity in treatment to the topic being discussed if significantly more comments were in favor or spoke against the issue. Future research should include both quantitative and qualitative measurements of cognitive dissonance, student engagement, and student value of the learning experience. Finally, future investigations should occur at multiple case sites to allow for enhanced generalizability.

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