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Team-based learning in an undergraduate capstone course: Examining the effectiveness of a learner-centered instructional method for farm management and operation students

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Team-based learning in an undergraduate capstone course: Examining the effectiveness of a learner-centered instructional method for farm management and operation students

by

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DEDICATION

I dedicate this dissertation to my late Father, Dennis Clay McCubbins and my late Mother-in-Law, Cheryl Poore Barth (Momma B).

Momma B, I wish you were here now. Your utter joy and strength throughout your last few years was so inspiring. Throughout this process, I faced many self-doubts. Your never-give-up attitude kept me going when I wanted to quit. Thank you for always supporting me.

Dad, you were one of the toughest and meanest men I knew. I will sincerely miss our conversations, your offerings of a ‘knuckle’ sandwich, and our chicken dinners. Not a day goes by that I am not thinking of you. I wish you could be here to celebrate this milestone with me, but I know you’re proud.

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NOMENCLATURE

TBL	Team-Based Learning
RAP	Readiness Assurance Process
RAT	Readiness Assurance Test
IRAT	Individual Readiness Assurance Test
TRAT	Team Readiness Assurance Test
SNA	Social Network Analysis
CLASSE	Class-level Survey of Student Engagement
SLE	Student Learning Experiences
ATA	Applied Thematic Analysis

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encouraging me and for sacrificing a ‘normal’ marriage while I pursued my dreams. All that I am, and all that I am yet to be, I owe to you.

ABSTRACT

The purpose of this dissertation was to describe the effectiveness of Team-Based Learning (TBL) in an undergraduate capstone course within the College of Agriculture and Life Sciences at Iowa State University. The effectiveness of TBL was measured in three ways, as outlined in the objectives for this study. The objectives were to: (1) Describe student perceptions regarding their beliefs and attitudes about learning, motivation to learn, and professional development through critical thinking; (2) Examine student engagement in a TBL formatted course via student reported frequency of engagement activities compared to instructor-rated importance of engagement activities; (3) Explore the impact a semester-long, TBL formatted capstone farm management course had on the growth and development of student social networks. For objective one, students completed a pre- and post-test regarding their experience in learning in groups, motivation to learn, and their development of skills relating to critical thinking. Objective two utilized a classroom-level engagement instrument to determine synergy or discord between student participation in–and instructor-rated value– of specific engagement activities. Objective three utilized a sociometric survey to determine collaboration networks among students in a TBL formatted course. Results from objective one indicated a positive increase across all three learning domains. Students felt that working in teams was a valuable way to spend class time and that being part of a team aided in their overall course performance. Perceived gains were also indicated on students' problem solving abilities as well as their ability to analyze and synthesize relevant information from course content. For objective two, the results indicated that the TBL-formatted capstone course engaged students at high levels. Students worked collaboratively to solve practical problems, utilized technology to complete assignments, and felt the classroom atmosphere was conducive for learning. Student

collaboration networks were analyzed to address objective three. Results determined that the collaboration networks among students are dynamic. The network was a cohesive and inclusive structure involving every student throughout both semesters. From this assessment, TBL can be considered an effective teaching method that promotes active learning, application of content, communication, problem solving, and decision making. The adoption of TBL in other courses across the agricultural education discipline can assist educators as they strive to ensure meaningful and engaging learning environments are created for all students.

CHAPTER I. INTRODUCTION

Educating students, and equipping them with the necessary skills and fundamental competencies to realize those skills in a professional context, is a primary focus of institutions of higher education (Samarasekera, Nayak, Yeo, & Gwee, 2014). Samarasekera et al. (2014) further posited that successful graduates must possess teamwork skills and the ability to communicate and act professionally. These skills are often referenced in defining 21st century learners (Moore, Odom, & Moore, 2013); the importance of these skills in addressing societal challenges cannot be overstated (Doerfert, 2011). If the intention of higher education is to provide competent, highly educated and skilled citizens capable of addressing 21st century issues (Doerfert), the transformation of traditional teaching methods must occur to engage students in an active way (Chickering & Gamson, 1987; Doerfert, 2011; Estepp & Roberts, 2013; Paulsen & Feldman, 1995).

How can instructors assure students become involved in the learning process? Many methods exist that aim to engage today's post-secondary students in the learning process, though it seems that university faculty are not utilizing them. The educational literature has explored this phenomenon and much of the discussion revolves around student-centered/ learner-centered instruction (Barkley, 2015; Gilboy, Heinerichs, & Pazzaglia, 2015; Horn, 2013; Prince, 2004), and several examine the benefits of active learning in comparison to passive learning (Roach, 2014; Roehl, Reddy, & Shannon, 2013; Tsui, 2002). Student-centered instruction (also referred to as: active learning, learner-centered instruction) has gained much traction in recent years (Hains & Smith, 2012; Prince, 2004). One particular method of student-centered instruction is known as Team-Based Learning (TBL) (Michaelsen, Knight, & Fink, 2004). This chapter provides a foundation for student-centered, active learning methods, particularly, TBL. The

background and setting that encompass this study, a problem statement, a description of the research objectives, definition of terms, and an overview of the significance of the study are also included in this chapter.

Background and Setting

Several studies have sought to examine the effectiveness of TBL (Baldwin, Bedell, & Johnson, 1997; Dunaway, 2005; Haidet & Fecile, 2006; Haidet, O'Malley, & Richards, 2002; Hernandez, 2002; Hunt, Haidet, Coverdale, & Richards, 2003; Koles, Nelson, Stolfi, Parmelee, & DeStephen, 2005; Lancaster & Strand, 2001; Levine et al., 2004; McCubbins, Paulsen, & Anderson, in press; Nieder, Parmelee, Stolfi, & Hudes, 2005; Ortega, Stanley, & Snavely, 2006; Parmelee, DeStephen, & Borges, 2009; Thackeray & Wheeler, 2006; Touchet & Coon, 2005; Vasan, DeFouw, & Compton, 2009; Vasan, DeFouw, & Holland, 2008), but limited research exists that studies the effectiveness of TBL in a comprehensive manner. In an effort to measure the effectiveness of TBL in a robust way, the effectiveness of TBL is examined from three viewpoints: 1) student preference for traditionally taught courses or TBL formatted courses via perceptions regarding their experience in both via a pre-test/post-test survey, 2) classroom engagement in a TBL formatted course compared to faculty-perceived importance of engagement practices, and 3) exploring the potential development and growth of social networks in a TBL formatted course.

In order to measure student perceptions of TBL, several instruments are utilized. Vasan, Defouw, and Compton (2009), developed an instrument to gauge student perceptions of TBL as well as their perceptions of teamwork in general. Mennenga (2012) developed the Team-Based Learning Student Assessment Instrument (TBL-SAI) which sought to measure student perceptions of TBL regarding accountability, preference of course design (lecture or TBL), and

satisfaction with TBL. The Classroom Engagement Survey (Baylor College of Medicine, 2001) is designed to measure learner enjoyment and participation in a TBL classroom. The Value of Teams survey (Baylor College of Medicine, 2001) examines students reported value of working in a group as well as working with peers. The aforementioned surveys are widely utilized in the existing TBL literature, but are limited by the overall scope. The Student Learning Experiences (SLE) survey (Bickelhaupt & Dorius, 2016) was chosen to measure student perceptions based on availability, quality of the survey, and its pre-test/post-test design. The SLE was developed to examine student perceptions regarding their beliefs and attitudes about learning, motivations to learn, and professional development through critical thinking. The pre-test instrument items are focused on student experiences in previous courses and the post-test instrument is focused on student experiences in current, TBL formatted course.

The Classroom Survey of Student Engagement (CLASSE) instrument is a classroom-level adaptation of the National Survey of Student Engagement (Smallwood and Ouimet, 2009). The CLASSE is intended to draw comparisons from the frequency of engagement with various educational practices (as reported by students) to the importance of those various educational practices (as reported by faculty members), in an effort to provide insights on enhancing educational practices (Ouimet & Smallwood, 2005). Data is collected from students within a specified course, as well as the instructor for said course. Improved student engagement at an institutional level is the primary purpose of the NSSE (Kuh, 2004) and the CLASSE was designed to provide classroom-level insights for the same purpose (Smallwood & Ouimet, 2009).

A researcher-created social network analysis instrument was used to collect information regarding student collaboration within the AgEdS 450 course. Student collaboration is an important aspect to measure when implementing a new teaching method for many reasons.

Gokhale (1995), introduced a collaborative learning approach to courses and noted an increase in student interest while also promoting critical thinking among students. Johnson and Johnson (1986) found that student collaboration resulted in higher levels of thought and extended the retention periods of information compared to students who worked individually. Student satisfaction within the learning environment also increases when students are tasked to work collaboratively (Strong, Irby, Wynn, & McClure, 2012). Perry, Retallick, and Paulsen (2014) suggested that students within the Department of Agricultural Education and Studies, the home department of AgEdS 450, need "communicative skill development" (p. 216).

This dissertation measures the effectiveness of TBL from three perspectives (student perceptions, student engagement, and social networks developed) in an effort to guide undergraduate education practices in colleges of agriculture.

Team-Based AgEdS 450 Course Organization

In order to fully comprehend the context of this study, a detailed description of AgEdS 450, Farm Management and Operation, and its structure in TBL format is essential. AgEdS 450 is Iowa State University's capstone course for Agricultural Studies majors and is grounded in Crunkilton, Cepica, and Fluker's (1997) work on designing capstone courses within colleges of agriculture. Crunkilton et al., (1997) define a capstone course as "a planned learning experience requiring students to synthesize previously learned subject matter content and to integrate new information into their knowledge base for solving simulated or real world problems" (p. 3). The goal of a capstone course is to "…ease transition of students between their academic experience and entry into a career or further study" (p. 4). The expected outcomes for the AgEdS 450 course follow Crunkilton et al.'s (1997) recommendations and include: a) problem solving, b) decision

making, c) critical thinking, d) collaborative/ professional relationships, e) oral communications, and f) written communications (p. 4).

At the time of the study, AgEdS 450 met three times weekly. The entire class met each Tuesday at an on-campus classroom for two hours. The lab portion, which met on the farm each Wednesday and Thursday was four hours in length. Half of the students were enrolled in the Wednesday lab, and the other half were enrolled in the Thursday lab. During the first class meeting, students were assigned to learning teams consisting of five to seven students. In an attempt to diversify teams, an instructor-created questionnaire was administered. Criteria for distributing students for diverse teams included: year in school, transfer status, major (double major and minor included) and number of internships completed. Brickell, Porter, Reynolds, & Cosgrove (1994) found that teacher-formed teams outperform student self-selected teams. Brickell et al. (1994) further posited that teams with existing cliques (friendships) can hinder team performance. The cliques can dominate discussion and decision-making by softening other team member's voices in those processes. The teams formed during the first day remained intact for the duration of the course. The first major decision the team made was the grade-weights of three performance areas in the course which included: individual performance, team performance, and team maintenance (peer evaluation). Individual readiness assurance tests (IRAT) comprised the weighting components within the individual performance category. The purpose of the individual performance category was to ensure students prepare before class, which also ensures that they contribute to their team (Michaelsen et al., 2004). Team performance included all team readiness assurance test (TRAT) scores as well as any application exercises or group projects that were graded. The team maintenance portion was comprised of several peer evaluations that occurred throughout the semester. Formative peer evaluations

occurred after large group projects and at the mid-point of the semester. A summative peer evaluation occurred at the end of the semester. The peer evaluations, a carefully structured component of the TBL model, were used to ensure each team member was contributing to the team performance and also served as a remedy for potential social loafing. Each student, as an individual and also as a member of a team, was held accountable with this grade-weight determination (Michaelsen et al., 2004). The practice of involving students in determining course policies (grade-weights) actively involved the student in the learning process (Michaelsen, Sweet, & Parmalee, 2011). Teams completed projects, application exercises, and TRAT's together during class meetings. Outside of class, individuals prepared by reviewing resources selected by the instructor that introduced students to the concepts to be covered within a given module. The preparation resources could include a series of articles and/or video media related to a particular topic. At the beginning of a module, an IRAT was administered, followed by the TRAT and then application exercises were completed. Figure 1 provides a visual representation of how students' progressed through the educational module. For a typical course, Michaelsen et al. (2004) recommended that the module cycle be repeated five to seven times. For AgEdS 450, seven modules were designed and implemented. Six of the seven modules lasted two weeks and one module spanned a three-week period.

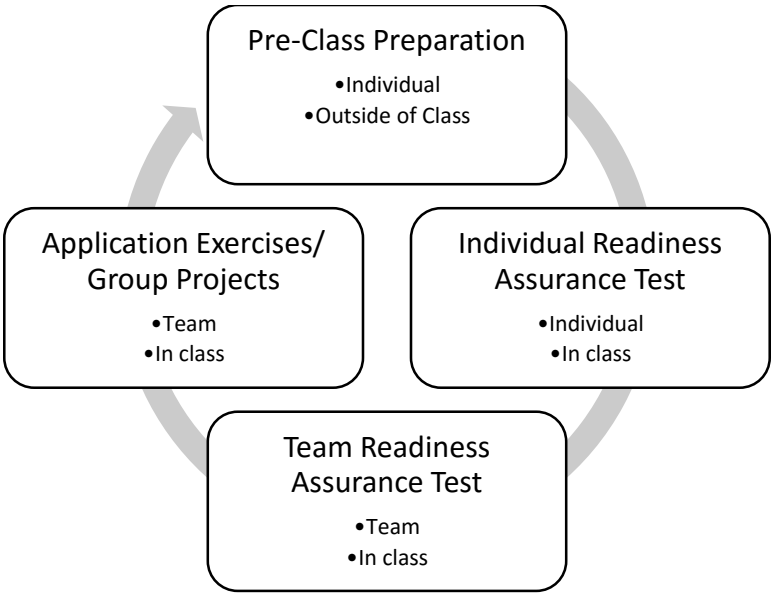

Figure 1. Flow of a Team-Based Learning Module in AgEdS 450

Figure 2 outlines how a typical class meeting and lab were conducted throughout the semester. During the first combined lecture period meeting for a given module, students completed the IRAT, TRAT, and received any clarifying instruction which sought to address misconceptions. During the split lab period, teams completed application exercises, worked on projects, and completed work related to the management and operation of the farm enterprise.

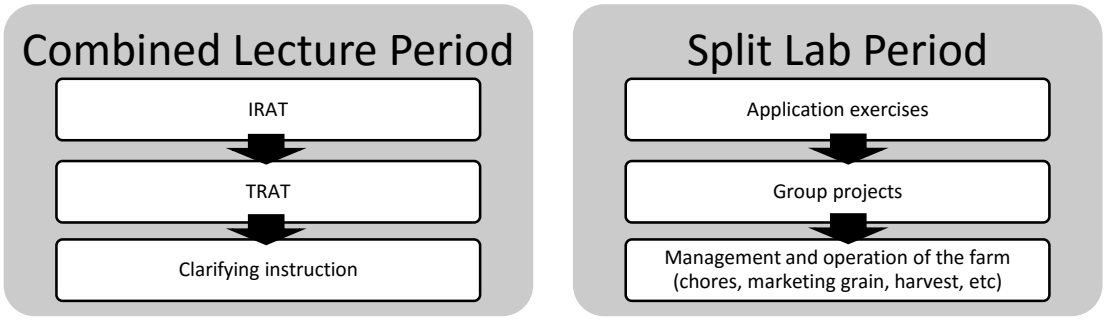

Figure 2. Combined Lecture and Split Lab Period Layout for AgEdS 450.

Statement of the Problem

The educational landscape is one that is rapidly changing and strategies for evaluating instructional methodologies is needed. Hutchings (2000) notes a need for the improvement of student learning in the overall profession of college teaching, and current research has highlighted the potential for collaborative learning, such as team-based learning, to foster metacognitive development in students (Iiskala, Vaurus, Lehtinen, & Salonen, 2011). Maxwell, Vincent, and Ball (2011) noted the role post-secondary agricultural educators could have in improving instructional practices. Maxwell et al. stated:

> An opportunity awaits agricultural educators in filling a need for training and examining the process of effective teaching at the post-secondary level, and faculty members in agricultural education as teacher educators can be positioned to lead the charge, not only [*sic*] their colleges but university wide, in developing faculty for effective practice in teaching. (p. 164).

A plethora of literature exists that has explored the benefits of TBL in the medical, engineering, and business fields at the post-secondary level; however, literature regarding this pedagogical practice within colleges of agriculture is scarce. Additionally, studies of TBL implementation in capstone courses within colleges of agriculture are limited (McCubbins et al., in press). With the recent push for students to be engaged and to take a more active role in the learning process, TBL may prove to be an effective way to ensure the passive role of students is eliminated. In order to adequately support that claim, there is a need to:

1. Examine student perceptions of the TBL method,
2. Study classroom level engagement in a TBL formatted capstone course, as well as

3. Investigate the intricacies of collaboration networks that are developed within TBL course.

AgEdS 450 was previously evaluated by Andreasen and Trede (2000). Stemming from the aforementioned evaluation, Andreasen and Trede (2000) suggested capstone course revisions focus on the development of student collaboration and communication. Student collaboration and communication have been identified as desired outcomes of a capstone course (Crunkilton et al., 1997). The transition of the AgEdS 450 course format to TBL was further supported by Andreasen and Trede's (2000) endorsement of revising course objectives to reflect the changing nature of student's previous academic experiences, specifically what they learned in prior courses. TBL allows students to spend more time applying course content versus passively receiving it (Sibley & Ostafichuk, 2014). Andreasen and Trede (2000) also favored continual evaluation of the emphasis of student-centered instructional approaches in AgEdS 450 along with the intentional planning for student-to-student interaction. The instructional approaches used in AgEdS 450 were enhanced by this student-to-student interaction, according to Andreasen and Trede (2000). More recently, Perry, Paulsen, and Retallick (2015) called for instructors of capstone farm management courses to use instructional approaches that emphasize student-centered discussions, oral and written communications, as well as issue analyses. TBL allows students to work in small groups while solving significant problems while engaging and drawing from other students' experience and knowledge (Michaelsen et al., 2004). For AgEdS 450, student evaluations concerning the course have been fundamental components in improving the structure and curriculum (Trede, Soomro, & Williams, 1992). Course completers have also been beneficial in determining the effectiveness of the course itself (Trede et al., 1992).

Objectives of the Study

The previous version of the American Association for Agricultural Education's National Research Agenda (Doerfert, 2011) called for the deepening of "our understanding of effective teaching and learning processes in all agricultural education environments" as well as "assess[ing] various learning interventions and delivery technologies to increase problem-solving, transfer of learning, and higher order thinking across all agricultural education contexts" (p. 9). An obvious void exists with the limited exploration of TBL's implementation in capstone courses. The purpose of this dissertation is to examine the effectiveness of TBL in a capstone course based on student perceptions, student engagement, and collaboration networks formed. This study is deeply rooted in Priority Area 4 of the National Research Agenda of the American Association for Agricultural Education (Roberts, Harder, & Brashears, 2016).

The following objectives were identified as a robust way to measure the effectiveness of TBL in a capstone course.

1. Research Objective One
    a. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development prior to completing the TBL formatted AgEdS 450 course.
    b. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
    c. Determine if there were changes in student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.

   d. Determine students' perceived improvement areas that would enhance TBL's implementation.

2. Research Objective Two
   a. Determine the importance of engagement-specific activities within the AgEdS 450 course as reported by the instructional team–instructor, teaching assistant, and the farm operator.
   b. Determine the frequency of student participation in engagement-specific activities within the AgEdS 450 course.
   c. Determine correlations between importance and frequency of engagement-specific activities within the AgEdS 450 course.
3. Research Objective Three
   a. Explore collaboration network map structures in a team-based learning formatted course.
   b. Determine if the collaboration network map change over the course of the semester.
   c. Determine if the collaboration networks became more inclusive throughout the semester.

Significance of the Study

The National Research Council (NRC; 2009) recommended academic institutions integrate opportunities for undergraduate students to develop communication, teamwork, and management skills. The NRC suggested that these skills should be developed in conjunction with content knowledge acquisition. With the demand for a competent, globally minded workforce; institutions of higher education must develop strategies to produce graduates capable of meeting

such a challenge (NRC, 2009). Even with the aforementioned challenge, students are exposed to classrooms that have not kept pace with the changing times (NRC, 2009). “Effective teaching in higher education incorporates pedagogical strategies that create hospitable classroom climates supporting diverse learning processes and cultural understanding” (NRC, 2009, p. 35). Even with the operational definition of effective instruction, the predominant approach to content delivery within agricultural education has been lecture (Ewing & Whittington, 2009; McCarthy & Anderson, 2000; NRC, 2009; Whittington, 1995).

More recently, McCormick and McClenney (2012) discussed the present disconnect between higher education research and classroom practice and offer potential solutions to bridge the gap. In particular, suggestions include how institutional engagement data could be utilized to inform the adoption of student-centered teaching methods (McCormick & McClenney, 2012). Although numerous barriers affect the adoption of research-based teaching and learning strategies, post-secondary instructors should carefully consider the potential benefit of research-based teaching strategies. Specific barriers identified by the Donovan, Bransford, Pelligrino (1999) provided the following explanation of the weak links between research and educational practice:

> The influence of research on educational practice has been weak for a variety of reasons. Educators generally do not look to research for guidance. The concern of researchers for the validity and robustness of their work, as well as their focus on underlying constructs that explain learning, often differ from the focus of educators on the applicability of those constructs in real classroom settings with many students, restricted time, and a variety of demands. Even the language used by researchers is very different from that familiar to

> teachers. And the full schedules of many teachers leaves them with little time to identify and read relevant research (p. 6).

Despite these barriers, some faculty use evidence based teaching methods. Although developed to conceptualize the influences of research on practice in secondary settings, the model for visualizing how research influences practice developed by the Donovan et al. (1999) provides useful insight for instructors at the post-secondary level. In an effort to support the adoption of student-centered pedagogical practices, this dissertation can be viewed as an attempt to strengthen the path through which research influences practice. Figure 3 depicts a conceptualization of how teaching and learning research affects practice, as adapted from the Donovan et al. (1999). The figure shows that most teaching and learning research is mediated by a number of factors before reaching classroom practice. Conversely, a direct link does exist between research and practice. The two-way arrow denotes that teaching and learning research can be directly transferred to classroom practice or classroom practice, and ultimately can lead to research on the teaching and learning process; however, this is rarely the case (Donovan et al., 1999).

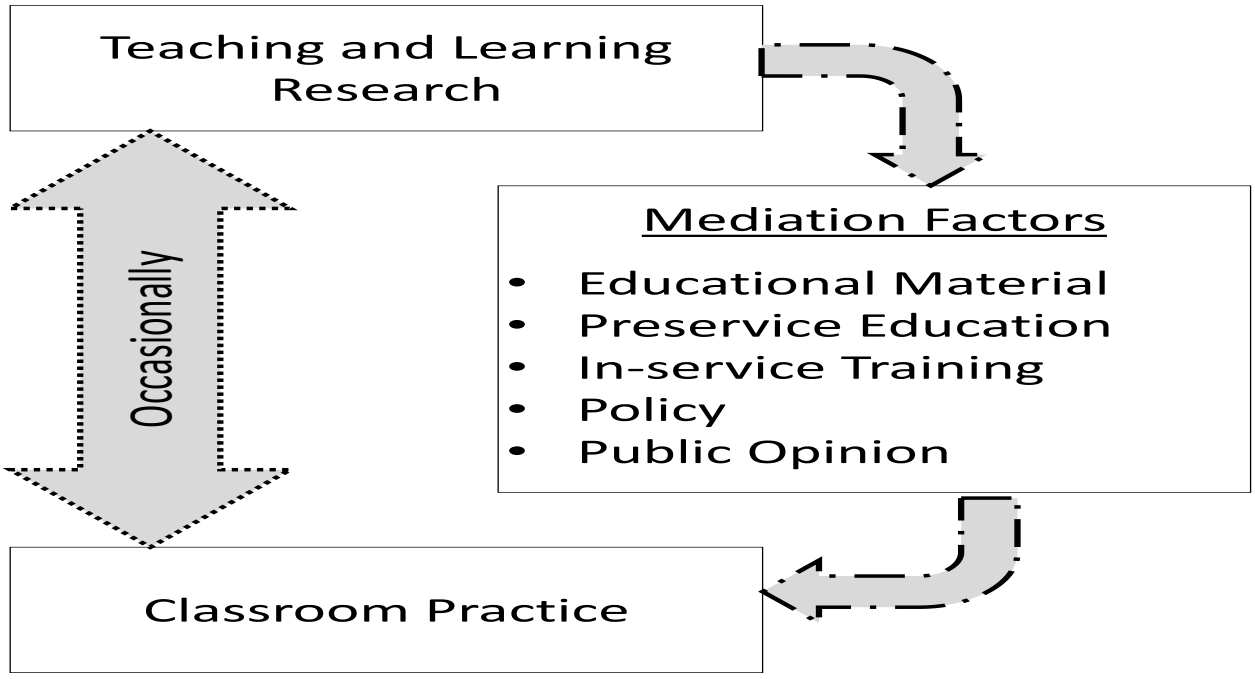

Figure 3. Model for the Transfer of Teaching and Learning Research to Classroom Practice. Adapted by OP McCubbins from "How People Learn: Bridging Research and Practice," by M. S. Donovan, J. D. Branford, and J. W. Pelligrino, 1999.

When teaching and learning research flows directly to classroom practice it is due, in part, to researchers and educators joining forces to develop meaningful experiments, or when research guides the adoption of a specific teaching or learning strategy by classroom practitioners (Donovan et al., 1999). Castle (1998) found that the lack applicability and the ambiguity found in educational research severely hindered the use of research by teachers. The teachers in Castle's (1988) study suggested that making the research easily available, providing evidence of the benefits of the research, and ensuring the research has practical applications as necessary in order to increase the utilization of research by teachers.

Teaching and learning research can be filtered through policy, the public, pre-service or in-service training, or the development of various educational materials. Policy filters are typically in the form of federal, state, or local policies or initiatives to incorporate a specific

strategy in classrooms. In order for the successful adoption of a programmatic change "…administrators must be persuaded of the value of that change, and must lend it legitimacy and support" (Donovan et al., 1999, p. 7). Saha, Biddle, and Anderson (1995) and Biddle and Saha (2000) found that administrators view research favorably and the cause for the favorable perceptions stemmed from possessing advanced degrees. Saunders and Rudd (1999) posited the use of research for school improvement initiatives presents several challenges to local authorities. The mediating factor of public opinion can include information about teaching and learning from popular media sources or individual's own experiences within the educational setting. Pre-service or in-service training can be guided by research-based practices, which may in turn influence the adoption or incorporation of these practices in the classroom. The development of educational material includes manuals or assistance materials for incorporation that may lead to research-based teaching and learning strategies to be adopted by classroom practitioners. These materials must incorporate the principles of learning in order for a higher potential for adoption (Donovan et al., 1999). As a consequence of these weak ties and lack of congruence among research to the four mediating filters, teachers "…struggle to adapt to competing demands. Strategies for change are often short-lived and responsive to fads rather than to sound research and theory" (Donovan et al., 1999, p. 8). Often, societal demands and institutional practice do not coincide (Hains & Smith, 2012). If strong ties between all factors are present, the adoption of research-based practices may be realized more efficiently. Huberman (1990) noted an increase in the energy exerted toward the dissemination of research when relationships are built between the researchers and practitioners.

Lee (1980) stated the implied purpose of Agricultural Education is to "… provide a supply of competent manpower for agricultural industry" (p. 3). Lee further explained that in

order to meet the implied purpose, post-secondary programs must assess the practices used to prepare students to ensure the professions teaching "inventory" is good practice: "Without the needed research base to document our inventory needs, we do not know the practices which allow us to most efficiently and effectively achieve our purpose" (p. 3). Lee noted the adoption of instructional practices that allows students to be passive absorbers of information within the learning environment. TBL may well be worthy of including in the professions inventory.

Gilboy, Heinerichs, and Pazzaglia (2014) discussed the limited research concerning the effectiveness of flipped classrooms and the need to examine them in robust ways. The results from this study can provide valuable information on the effectiveness of the TBL pedagogical practice in a capstone course within a College of Agriculture and Life Science. Results may be useful for other colleges of agriculture as they push for more student-centered classrooms. By examining this teaching modality, faculty members within colleges of agriculture may be exposed to the benefits of TBL as a viable pedagogical method and consider potential adoption of this student-centered approach. If proven as an effective way to engage the diverse learners encountered in classrooms today (NRC, 2009), adoption resistance of student-centered pedagogical practices should decrease, strengthening the tie between research and classroom practice, as shown in Figure 3; and further addressing the challenge to improve instructional practices (Chickering & Gamson, 1987; Roberts et al., 2016; Estepp & Roberts, 2013; Paulsen & Feldman, 1995).

Dissertation Organization

This dissertation is arranged in seven chapters. Chapter I provides a general introduction to active learning, social networks, and TBL. Chapter II explores the current literature surrounding TBL, student-centered/active learning, and social networks. Chapter II also provides

the conceptual and theoretical underpinnings of active learning strategies funneling down to TBL. Chapter III outlines the methodology employed for this dissertation. Context specific methodology for each of the three main objectives utilized to satisfy the overall purpose of this dissertation are also included in chapter III. Chapter IV provides a research manuscript that examines and compares student perceptions of their experience within three constructs in previous courses as well as in a TBL formatted course, satisfying objective one. Chapter V, focuses on objective two and provides a research manuscript that describes student engagement through the comparison of student participation and instructor value of engagement-specific activities AgEdS 450. Chapter VI provides a research manuscript that explores student collaboration networks in a TBL formatted capstone course, addressing objective three. Chapter VII discusses the overall conclusions, implications, and recommendations gleaned from the study in its entirety.

Definition of Terms

Contextual and operational definitions of key terms used in this study are as follows:

- Capstone Course- an intentionally designed course that requires students to solve simulated or real-world problems with new information integrated with previously learned subject matter content (Crunkilton, Cepica, & Fluker, 1997).
- Active Learning- umbrella term for a variety of collaborative classroom activities which are student-centered, highly motivational, and designed to maximize participation that encourage a transition from rote memorization of course content (McCarthy & Anderson, 2000).
- Student-Centered Learning- an instructional approach that implements team-based activities that require critical thinking, reflection, and simulations or role-plays (i.e., real-

world problems), while holding students accountable for their learning (Felder & Brent, 1996).

- Learner-Centered Instruction- an instructional approach coupled with teacher qualities that supports the co-creation of activities that improve motivation, increases achievement, and enhances learning (McCombs, 2001).
- Flipped Learning- instructional approach where teachers make lessons available outside of the traditional classroom. Students can review the lessons whenever it is convenient for them, resulting in face-to-face time being spent on collaborative assignments (Barkley, 2015).
- Team-Based Learning- an active, student-centered teaching approach that emphasizes the use of small groups and the application of content knowledge through structured exercises (Michaelsen, Knight, & Fink, 2004).

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CHAPTER II. LITERATURE REVIEW

The purpose of this study was to examine the effectiveness of TBL in a capstone course based on student perceptions, student engagement, and collaboration networks formed. The following objectives were identified as a robust way to measure the effectiveness of TBL in a capstone course.

1. Research Objective One
    a. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development prior to completing the TBL formatted AgEdS 450 course.
    b. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
    c. Determine if there were changes in student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
    d. Determine areas of improvement that would enhance TBL's implementation as perceived by students.
2. Research Objective Two
    a. Determine the importance of engagement-specific activities within the AgEdS 450 course as reported by the instructional team–instructor, teaching assistant, and farm operator.
    b. Determine the frequency of student participation in engagement-specific activities within the AgEdS 450 course.

c. Determine correlations between perceived importance and frequency of engagement-specific activities within the AgEdS 450 course.

3. Research Objective Three
    a. What does a collaboration network map look like in a team-based learning formatted course?
    b. Does the collaboration network map change over the course of the semester?
    c. Did the collaboration network become more inclusive?

This chapter will explore the relevant literature essential to establishing an operational understanding of capstones courses, active learning, student-centered learning, team-based learning, and social network analysis (SNA). The theoretical and conceptual basis of this study will also be examined.

AgEdS 450, Farm Management and Operation

The AgEdS 450 course, the subject of this study, is a farm management and operations course for Agricultural Studies majors within the Department of Agricultural Education and Studies. Murray (1938) noted the importance of bringing students extremely close to important managerial decisions in farm management instruction. Murray taught a course on farm management that utilized local farms as learning laboratories but felt something was lacking (Murray, 1945). The students would regularly visit farms in the Ames area and worked with the operators to discuss vital management decisions. Students compiled recommendations for the operators and submitted them at the end of the course to establish permanent records (Murray, 1938). Murray (1945) noted that the absence of a dedicated farm for the farm management course provided "…no opportunity for the students to make management decisions themselves" (p. 186). Murray (1945) opined that a student graduating from college with hopes of operating a

farm should be well versed in four fields: 1) farm practices of his area, 2) scientific principles of crop and animal production including the use of power and equipment, 3) business principles of farming, and 4) making management decisions (p. 186). In 1943, the AgEdS 450 course, along with a farm as the laboratory was created to provide practical experience for students in a production agriculture major (Murray, 1945). The farm and an initial operating budget was provided under a teaching equipment category of funds, just as microscopes or machinery were provided to other departments (Murray, 1945), and the payments were eventually picked up by the class and the entire purchase price satisfied (Wallace, 1963). Students in the early iteration of the course made the decision to hire all work on a custom basis from existing college services based on an analysis of equipment prices (Murray, 1945). These decisions, and any other management related decisions were the student's responsibility. The college administration required each expenditure be approved by the instructor-in-charge, which provided students the opportunity to justify decisions via written reports or oral presentations (Murray, 1945). The students would collect pertinent information and present it to their fellow classmates before a vote took place. If the vote passed and the instructor-in-charge was satisfied with the analysis of information, the decision was then passed to the administration; this was the only involvement in official business meetings held by the class unless otherwise asked (Murray, 1945). Murray (1945) noted the impact that opportunities to make mistakes has on student learning:

> In the first year of operation, the students proposed a new field layout which required the building of a lane fence. When the plan was approved by the class the student in charge went over it with Mr. Pricht, the man at the farm [the farm operator hired by the students]. Mr. Pricht pointed out that the lane was not wide enough especially where it made a right angle turn. The student insisted, however, that the width was sufficient so

> Mr. Pricht proceeded to install the fence as directed. All went well until haying time. The first load of hay could not make the turn in the lane so the fence had to be taken down to let it through. Any loss of time, however, was more than made up by the value of the lesson to the students (p. 190).

Students, when faced with making decisions and implementing those decisions, are forced to deal with any consequences thereafter.

The students are able to learn by doing. Wallace (1963), who at the time had been teaching the course for approximately four years of its 20 year existence, expressed sheer amazement at "…how much students do learn from actually *doing* [emphasis in the original] the job of making management decisions" (p. 563). An important distinction was proffered by Wallace (1963) in that the Ag 450 course is not, nor should not be viewed as a substitute for courses in farm management principles but a course where the farm management principles could be applied in a real-world setting. As the course continued to grow and develop, the student's functions as managers did as well. In order to keep all course alumni up to date, current students completed a detailed analysis of all decisions made each year. This information, paired with a field day, allowed the alumni to see how the decisions they made impacted the farm (Wallace, 1963). Peer influence was noted as a strong motivator in the early years of the course and each decision made had to stem from a majority vote. This enabled each student to discuss critical details concerning decisions to be made and served as reinforcement to dissuade irrational decisions; students did not want the next cohort of student-managers to think of them as incompetent (Wallace, 1963). As the farm entered the 1980s, decisions became slightly automated with the incorporation of the microcomputer ("History of Ag 450 Farm," n.d.).

The effectiveness of the microcomputer in decision-making was examined in a supplemental educational program known as the Winter Farm Operations Program (Johnson, Carter, & Miller, 1984). The Winter Farm Operations Program existed for 40 years and served as a two-year certification program while the traditional Farm Operations Curriculum led to a Bachelor of Science degree ("Department History," n.d.). Both of these programs were offered through the Department of Agricultural Studies. The curriculum itself was renamed Agricultural Studies – Farm Operation in the 1980s, and then changed to Agricultural Studies in 1991, two years after the Department of Agricultural Studies merged with the Department of Agricultural Education to form the Department of Agricultural Education and Studies ("Department History," n.d.). The enterprises on the Ag 450 Farm have also undergone several changes throughout its history.

Honeyman (1985a) noted cropping enterprises have been in corn, soybeans, oats, pasture, hay, popcorn, and diverted (i.e., production on land halted for a government program). From 1943 to 1981, corn, soybeans, and hay production were constant. The Ag 450 Farm has contained the following livestock enterprises: poultry, dairy cows, draft horses or mules, farrow-to-finish hogs, ewe flock, and beef cattle feeding (Honeyman, 1985a). Farrow-to-finish hogs were the only livestock enterprise in continuous operation through 1981. Honeyman (1985b) noted that specialization and capitalization has occurred over the years, particularly in the areas of the corn and swine production, and opined the exemplification of "Science with Practice," the university motto (p. 12). Presently, the Ag 450 Farm is responsible for over 1,400 acres, with corn, soybeans, and hog production as the staple commodities ("History of Ag 450 Farm," n.d.). In making management decisions for the Ag 450 Farm, Honeyman (1985a) noted how much students learn from one another and stated:

> During the discussions, students often learned from each other. New ideas and original approaches were gained through interaction with those of differing backgrounds or experiences. Frequently students often came to know their Ag 450 classmates better than those in any other college course (p. 56).

Additional activities that contribute to this level of knowing classmates includes carrying out the physical activities involved in operating a farm as well as required hours to get acquainted with the course. In particular, students were required to spend eight hours outside of class time in order to become familiar with previous decisions and general farm policies (Honeyman, 1985a). At the time of this study, students were required to complete ten additional hours outside of class time to fulfill that same expectation (McCubbins, 2016). AgEdS 450 is unique to Iowa State and a similar course is not known ("History of Ag 450 Farm," n.d.; Honeyman, 1985a). Honeyman (1985a) further stated that "one true test of education is in its application; in Ag 450, that application is in the decision-making process" (p. 68). Applying management principles has been a focus of the Ag 450 course since its inception (Murray, 1945; Wallace, 1963) and the burden of success or failure in making such decisions rests upon the shoulders of the students (Honeyman, 1985b).

Trede, Soomro, and Williams (1992) sought to determine the appropriateness and usefulness of the course content covered in Ag 450. Trede et al. found that alumni regarded all components of the course as above average appropriateness. That is, course alumni thought each component was appropriate for Ag 450 to cover. Utilization of an actual farm as a laboratory was the highest rated procedures used in the Ag 450 course. Students felt this contributed most to the effective teaching of the course itself. In support of Honeyman's (1985a) claim that students develop deep interpersonal relationships, Trede et al. opined that the course provides critical

experience in interpersonal relationships that graduates should possess; such experience included working with others and membership on farm committees. These findings were further supported in the work by Andreasen and Trede (2000) who found that student-student interaction far exceeded the amount of student-student interaction in similar capstone courses. The modern course is designed around Crunkilton, Cepica, and Fluker's (1997) framework for capstone courses, which includes the following educational outcomes: 1) teamwork, 2) problem-solving, 3) critical thinking, 4) communication, and 5) decision-making. Andreasen and Trede (2000) concluded that the course design clearly fits the Crunkilton et al. framework and aided in reinforcing critical thinking skills.

The importance of small group work, solving problems, analyzing farm data, and making decisions as vital factors in farm management instruction was expounded by Murray (1938). The importance of these aspects are further supported in Crunkilton et al.'s (1997) framework for capstone courses. Trede and Andreasen (2000), interested in specific experiential learning activities contained within the Ag 450 Farm, concluded that course graduates regarded teamwork, group decision-making skills, exchanging ideas, and being responsible for their own learning as beneficial in their first professional position. Trede and Andreasen (2000) declared that group decision-making skills and teamwork should continue to be emphasized in the course. The importance of students making decisions and solving problems, as expressed by the previous researchers (Andreasen & Trede, 2000; Honeyman, 1985a; Honeyman, 1985b; Johnson et al., 1985; Murray, 1938; Murray, 1945; Trede & Andreasen, 2000; Trede et al., 1992; Wallace, 1963), requires them to be wholly involved in all aspects of the farm. "This type of teaching and learning provides students the opportunity to become involved in all facets of the farm as a means of learning about management and operations" (Vogel & Steiner, 2004, p. 974). The value

of the AgEdS 450 course has been documented through various research studies, departmental reviews, and various outreach programs (Vogel & Steiner, 2004). In order to achieve the intended educational goals of Ag 450, Perry, Paulsen, and Retallick (2015) noted the various instructional approaches used, and the importance of critical thinking. While Perry et al. concluded that the course does not improve overall critical thinking abilities, Ag 450 does reinforce specific critical thinking abilities (i.e., separating relevant from irrelevant information). This aligned with Andreasen and Trede's (2000) conclusion that the course reinforced critical thinking abilities. McCubbins, Paulsen, and Anderson (in press) drew a similar conclusion, however it should be noted that the course structure underwent a major revision in an effort to satisfy recommendations from several researchers (Andresean & Trede, 2000; Trede & Andreasen, 2000; Perry, Paulsen, & Retallick, 2015) concerning the structure and emphasis of the Ag 450 course. McCubbins et al. found that peer influence remained a vital factor in the course, echoing Wallace's (1963) assertion.

The tenets of AgEdS 450 may provide a unique opportunity to foster the growth of skills desired by employers as noted by previous research (Lamm, Carter, & Melendez, 2014; Lamm, Carter, Stedman, & Lamm, 2014), while engaging students in solving complex, real-world problems (Hoppe & Reinelt, 2010).

Capstone Courses

A capstone course is defined as "a planned learning experience that requires students to synthesize previously learned subject matter content and to integrate new information into their knowledge base for solving simulated or real world problems" (Crunkilton et al., 1997, p. 3). Further, capstone courses should provide meaningful closure to students' academic experiences and focus on integrating their fragmented disciplinary knowledge (knowledge from previous

courses or experiences). Easing students' transition from academic experiences to further academic study or their entry into the workforce is an important purpose of a capstone course (Crunkilton et al., 1997). Conceptualizations of a capstone course experience within Agricultural Education can include the student teaching experience or an internship (Andreasen & Trede, 1998; Crunkilton et al., 1997; Edgar, Roberts, & Murphy, 2011; Smalley, Retallick, & Paulsen, 2015).

While the conceptualization can differ, Crunkilton et al. (1997) identified the following six expected educational outcomes of capstone courses; 1) problem solving, 2) decision making, 3) critical thinking, 4) collaborative/ professional relationships, 5) oral communications, and 6) written communications (p. 4). In order to meet these outcomes, Crunkilton et al. established five learning activities that should be an "integral part" of capstone courses and include; 1) projects, case studies, or issue analysis, 2) small group work, 3) oral communication activities, 4) intensive writing, and 5) industry involvement (p. 6-7). These learning activities can also be realized in various ways and have been highlighted throughout the literature.

Projects can refer to a number of educational activities. Downey (2012) found that students were most receptive to projects and other assignments that focused on the application of course content to real-world situations. Projects are typically completed independent of the instructor and should result in some form of a written report or paper (Crunkilton et al., 1997). Projects may be conceptualized by some as case studies, case analyses, or issue analyses. Case studies require students to engage in a hypothetical or real problem. Student groups will be required to "define and clarify the problem, evaluate the nature of the problem, analyze the data, and decide upon alternative solutions…" (Crunkilton et al., 1997, p. 5-6). Case analyses require interpretation and synthesis of information (Kerka, 2001); similarly, Paulsen (2010) noted that

issue analyses allow students to work in small groups while researching a significant issue and make decisions and develop solutions around the issue. Kerka (2001) noted the incorporation of considering the "big picture" when students develop research skills and begin integrating information in making judgments on various analyses carried out in career and technical education courses. Assignments that provide students background information and guided questions on a hypothetical or real problem/ situation, and require students to analyze both sides of the problem, evaluate how solutions affect those involved, and finally reach a resolution are particularly useful in a capstone setting (Crunkilton et al., 1997; Kerka, 2001; Paulsen, 2010; Wagenaar, 1993).

Oral communications can be incorporated in many aspects of a capstone course. Oral reports can be delivered by students (Crunkilton et al., 1997), via storytelling to share ideas or culture (Kerka, 2001) or it can be emphasized in debates/discussions (Wagenaar, 1993; Zimmerman, 1991; Zimmerman, 1997). Crunkilton et al. declared that presentations should be engaging and informative, and should be graded on content, logic, organization, clarity, and professionalism.

Similarly, the infusion of intensive writing assignments can be integrated in several ways. Intensive writing is defined as "written assignments comprising no less than a total of 15 type-written, double spaced, referenced pages" (Crunkilton et al., 1997, p. 6). This could be in an all-inclusive document or in a series of written reports totaling 15 pages. Zimmerman (1991) utilized journaling throughout a problem solving capstone course at a technical college in Ohio in an effort to increase content engagement among his students. Journaling was emphasized even more in the revised capstone course in Ohio in order to enhance student learning on all topics within the course (Zimmerman, 1997). Zimmerman (1997) noted that the writing allowed the

students "… to actively engage in self-directed analysis and learning" (p. 43). The assigned journaling throughout the course allowed the students to document and measure their understanding of the course content.

Small group work refers to students engaging in projects or assignments with other students, and as outlined by Crunkilton et al. (1997) should include three to five students. Downey (2012) proposed similar team numbers, although his included an industry representative as an integral team member for a final project in his capstone course. He noted that teams of two or three student's lacks formality and the ability to offer quality feedback while groups larger than five became burdensome.

Industry involvement has tremendous potential to fill gaps in the educational landscape. Downey (2012) utilized industry representatives to offer real-world connections during a final project presentation. Henneberry (1990) posited that the theory-to-application gap could be traversed with strategic industry partnerships. Potential benefits offered by bridging this theory to application gap included greater student confidence and demeanor, and increased familial support of the educational process. Industry representatives can offer credibility, concrete examples of theory and course content applications in the real world, and improve student motivation (Henneberry, 1990). McCarthy (1985) also noted the importance of academic and industry partnerships. Industry partnerships can often ease financial burdens and can also serve as an important source of technically current information (Downey, 2012; McCarthy, 1985). The examples follow Crunkilton et al.'s framework which includes activities where students and representatives from industry are brought together in some form. These activities must be planned in such a manner to meet educational goals.

Capstone courses and the required components are especially important to agricultural education programs because of the changing agricultural environment. Nilsson and Fulton (2002) suggested that the changing environment is influencing how university faculty develop curriculum. Furthermore, Litzenberg and Schneider (1987) reported that potential employers felt that university faculty members and overall programs must be proactive in keeping students' technical and social skills up to industry standards. In following the framework and incorporating the learning activities required in capstone courses, students *needs* and *wants* may be addressed; an important consideration in designing curriculum (Blank, 1987). In regards to the importance of these components to AgEdS 450, Andreasen and Trede (2000) surveyed AgEdS 450 course completers and found overwhelming support for each of the activities included in the course. Students reported favorably in regards to the specific activities and outcomes of the course which included solving problems, making decisions, working with others, preparing reports, analyzing farm documents, and evaluating technologies. In comparison to other junior/senior level course, Andreasen and Trede (2000) found that 92% of AgEdS 450 completers felt that AgEdS 450 provided more opportunities for hands-on activities. These hands-on activities included experiential learning, contact with industry representatives, and working with other students. Incorporating a capstone course at the end of a student's academic career has the potential to aid in ensuring graduates have the technical and social skills desired by employers.

Examining How Students Learn

A basic understanding of cognition is imperative when designing instruction (Sweller, van Merrienboer, & Paas, 1998). Sweller et al. (1998) suggested two forms of memory in the cognitive architecture of individuals including working memory and long-term memory. Working memory has limited space (Miller, 1956), and is generally utilized to "process

information in the sense of organizing, contrasting, comparing, or working on that information in some manner…" (Sweller et al., 1998, p. 252). In contrast, long-term memory is able to store mass amounts of information that can be utilized in completing complex tasks (Ericsson & Kintsch, 1995). This information is utilized in complex processing, but only through retrieval and integration into the working memory space.

In order to develop new knowledge and incorporate it into their long-term memory space, students must engage the working memory (Sweller et al., 1998). Because the working memory is limited in capacity (Miller, 1956), delivering massive amounts of information via lectures overloads it. Knowledge, then, is only useful when students can retrieve it from their long-term memory storage when needed (Michaelsen & Sweet, 2011). This layout of cognitive structures allows students to relate new information to what is already known (Mennenga, 2012). To ensure the learning is meaningful, there is an "…absolute necessity to connect new information to knowledge already stored in one's existing memory networks" (Goff, Terpenny, & Wildman, 2007, p. 17).

How students learn is explained in great detail in the book, *Teaching At Its Best* (Nilson, 2010). Key learning principles are complemented with teaching principles. To summarize Nilson (2010), instructors should; hold students to high expectations, but remain flexible, use the students' background knowledge as a starting point, connect the material to students' lives, manifest enthusiasm in the learning environment, incorporate small-group assignments that are challenging, utilize active learning strategies, create experiential learning opportunities for students, and include low-stakes assessment techniques regularly.

Active Learning/ Student-Centered Learning/ Learner-Centered Instruction

Teacher-centered instructional approaches are not working for diverse student populations (Brown, 2003). Engaging students in a didactic lecture-based course is often difficult to achieve, yet many courses emphasize the didactic lecture method of teaching. The goal in this method is to transfer information directly to the student from the teacher (Hrynchak & Batty, 2012). “In most forms of higher education, teachers traditionally design their course by asking themselves what they feel students need to know, then telling the students that information, and finally testing the students…” (Michaelsen, Parmalee, McMahon, & Levine, 2008, p. 13). Duron, Limbach, and Waugh (2006) espouse that students resort to memorization of content because of the large amount of information delivered in lecture formats. This method encourages students to assume a passive role in the learning process. Within agricultural education, several studies have documented the use of lecture methods and their propensity for reaching lower levels of cognition (Estepp, Stripling, Conner, Giorgi, & Roberts, 2013; Whittington, 1995; Whittington & Newcomb, 1993; Whittington, Stup, Bish, & Allen, 1997).

Research has shown that students learn more when actively engaged than from lecture based teaching methods (Armstrong, Chang, & Brickman, 2007; Fagen, Crouch, & Mazur, 2002; Hake, 1998; Wright et al., 1998; Knight & Wood, 2005; Michael, 2006;). Adoption of active learning instructional approaches by faculty members has been slow, despite an overwhelming amount of supporting research (NRC, 2009).

King (2012) proffered that active learning can be simply defined as getting the students involved in the content of a course versus the students merely receiving the content for memorization purposes. More active learning methods have become popular in recent years and further discussed as a needed element in education and professional development activities

(Conner et al., 2014; Shoulder & Myers, 2014). Doerfert (2011) suggested that meaningful learning goes beyond rote memorization. Students should develop the ability to transfer the understanding of concepts to new situations, solve problems, and develop skills. This requires a shift to more active, or student-centered learning practices. In sum, active learning can be viewed as any instructional method that engages students in the learning process, otherwise used as an umbrella term to cover student-centered teaching/ learner-centered instruction.

Student-centered learning methods can be traced back to early pundits of education and tracked to present day literature (Bergmann & Sams, 2012; Chickering & Gamson, 1987; Conner et al., 2014; Dewey, 1916; Hurd & Gallagher, 1968). Dewey (1916) asserted "…it is impossible to procure knowledge without the use of objects which impress the mind" (pp. 766-767). Although the terms are interchanged, the central point remains the same; engage students in the learning process. Utilizing active learning techniques is one of the seven good practices in undergraduate education as developed by Chickering and Gamson (1987). Students learn very little by simply listening to teachers, and students "must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves" (Chickering & Gamson, 1987, p. 4). Once exposed to active learning strategies, students report lecture-based instruction as ineffective (Chickering & Gamson, 1987; Mennenga, 2012).

Increased student engagement is not the only documented benefit of active learning: Active learning strategies are also often credited for improving student critical thinking (Duron, Limbach, & Waugh, 2006; Popil, 2011; Yang, 2012). Why is an increase in critical thinking important for today's learners? Rollins (1990) posited students must deal with an abundance of complex information and knowledge in systematic ways in order to function in their future

occupation (p. 47); making it critical for students to develop critical thinking skills in order to compete/excel in the workforce.

With an abundance of research that supports student-centered learning (Chickering & Gamson, 1987; Conner et al., 2014; Hains & Smith, 2012; Richmond & Hagan, 2011; Whittington, 1995), why do some educators fail to adopt this modality? Knight and Wood (2005) found that students and teachers experienced discomfort when transitioning into a more active learning environment, even though student learning was increased. Hains and Smith (2012) further defined the three sources of resistance toward adopting student-centered pedagogy outlined by Johnson et al., 2009. Those barriers stemmed from three main areas and included: 1) individual, 2) administration, and 3) students. The National Research Council (NRC; 2009) noted that classroom architecture may also act as a barrier to implementing active learning.

Barriers to Implementing Student-Centered Instruction

Individual

Hains and Smith (2012) presupposed that the individual (i.e., the teacher) barrier for adopting student-centered pedagogy is heavily dependent on the epistemology that the teacher is the authority in the learning environment. By utilizing a teacher-centered, lecture-based approach to teaching, instructors are altogether avoiding the transformative aspects of teaching and learning. Felder and Brent (1996) posited that time commitment, fear of losing control of the learning environment, and previous negative experiences with students working in groups, as specific factors to the individual barrier of implementing student-centered activities. Donovan et al. (1999) further supported the time constraints of educators by suggesting the full schedules of instructors leave little time for acquaintance with research-based best practices. That is, instructors cannot dedicate time to familiarizing themselves with the required components of

implementing a student-centered teaching strategy, as described in the literature. Whittington (1995) posited that although faculty members within colleges of agriculture reached mostly lower levels of cognition in their classroom discourse, they may feel apprehension in adopting new teaching modalities. Whittington further suggested that faculty members work to revise their practiced discourse in order for students to reach higher cognitive levels.

Administration

The administration barrier is comprised of the increased demands of higher education institutions as a whole (e.g., research, budget restrictions, and evaluations). Administrations may not support faculty effort in designing courses that are student-centered because of an increased emphasis placed on research versus teaching (Center for College Affordability and Productivity, 2010; Hains & Smith, 2012). The Center for College Affordability and Productivity (CCAP) (2010) concluded that universities operate on the premise of two major academic functions. The first function is teaching and the second being research. CCAP (2010) argued that a strong bias exists to emphasize research instead of teaching and pointed out that the promotion and tenure process is heavily research-based. CCAP (2010) noted that "…teaching evaluations count for little in the tenure review process" (p. 88). Lack of support from the administration could also stem from student complaints because the students are not comfortable with the transition of power (Felder & Brent, 1996).

Student

An additional barrier to adopting student-centered pedagogical practices involves the students. Hains & Smith (2012) declared that students are often "…indoctrinated with teacher-centered pedagogy…" (p. 360). Felder and Brent (1996) provided further evidence of the

student barrier by explaining faculty concerns on the implementation of student-centered activities:

> The problem is that although the promised benefits are real, they are neither immediate nor automatic. The students, whose teachers have been telling them everything they needed to know from the first grade on, don't necessarily appreciate having this support suddenly withdrawn. Some students view the approach as a threat or as some kind of game, and a few may become sullen or hostile when they find they have no choice about playing. (p. 43)

Student resistance to student-centered instruction has been documented as early as Socrates. Socrates experienced student resistance when conclusions he led students to reach, differed from their personal beliefs (Bowen, 2005). Trosset (1998) also discovered student resistance to active learning techniques. If the students didn't have previously held, firm beliefs regarding a particular topic, they preferred to abstain from active discussion.

Classroom Architecture

The NRC (2009) identified classroom architecture as a possible barrier to implementing active learning strategies. Traditional classrooms found on college campuses were likely not designed with active learning in mind. Complete renovation of campuses would be a significant financial hurdle. The NRC (2009) suggest universities "…seriously consider pedagogy and instructional needs as part of the planning for new construction and renovation" (p. 46).

With a call to transform undergraduate education to include more active, student-centered activities (Estepp & Roberts, 2013), instructors in colleges of agriculture must look beyond the barriers and continue to transform traditionally taught courses in order to engage today's

learners. Barriers stemming from the individual, administration, or the student, although burdensome, can be surmounted (Felder & Brent, 1996; Hains & Smith, 2005; King, 2012).

Student Engagement

Student engagement is interwoven within the premise of active learning activities. Can you have one without the other? To adequately understand the importance of student engagement in the learning environment, it is critical to provide an operational definition, as a consensus on the meaning is lacking (Bowen, 2005). Bowen (2005) suggests four priorities of student engagement: student engagement with the learning process, student engagement with the object of study, student engagement with contexts, and student engagement with the human condition (p. 4). Student engagement with the learning process is touted as the most fundamental for education as a whole and is succinctly summarized as getting the students involved in the learning process (Bowen, 2005). Bowen further suggests that engaging students *in* the learning process is characterized by the umbrella term, active learning.

Student engagement in the learning environment has been examined extensively in the literature (Chickering & Gamson, 1987; Ewing & Whittington, 2009; Goff, Terpenny, & Wildman, 2007). Several studies have found low levels of student engagement when a lecture-based teaching method is used (Chickering & Gamson, 1987; Ewing & Whittington, 2009; McCarthy & Anderson, 2000; Mennenga, 2012; Whittington, 1995), and that student engagement increases when active learning strategies are utilized (Lightner, Bober, & Willi, 2007). Students are the primary agents of learning, and learner-centeredness is vital if teaching is to be improved (Bowen, 2005). How do we ensure learner-centeredness in the learning environment? With engagement as an intentional thought process when planning instruction.

Roberts, Dooley, Harlin, and Murphrey (2006) found that the "ability to involve everyone" (p. 11) within the learning environment is of paramount importance for successful teaching. Concurrently, faculty members at higher education institutions report that class sizes are increasing and, as a result, interaction and involvement of students in the learning process is decreasing (Goff et al., 2007). Lack of student engagement can lead to students choosing to not attend classes. Frequently cited reasons from students about choosing to not attend a class include the class being boring, lectures not being of good quality, and the teacher not presenting information in an interesting way (Stripling, Roberts, & Israel, 2013). Mann and Robinson (2009) discovered a "…intolerably high percentage of 'boring' lectures at university level…" (p. 253). Instructors must be attentive to the students throughout the course. Intentional flexibility is important if visual gauging of student engagement in the content is waning; a variety of activities can be implemented to reel students back in (Goff et al., 2007).

With the literature supporting increased engagement and student-centered courses, instructors within colleges of agriculture must strive to transition from the 'sage on the stage to the guide on the side' (King, 2012). Resources to aid in the transition from passive learning to active learning strategies are also provided in the literature (Bonwell & Eison, 1991; Conner et al., 2014; Knight & Wood, 2005). Michael (2006) and Prince (2004) provide a detailed analyses of active learning strategies and why they work.

Active learning techniques could include the simple addition of various student activities in the traditional classroom. An instructor could implement a "think-pair-share" activity (King, 2012) and then simply continue with didactic lecture. While research shows that this is somewhat beneficial in improving student engagement (Sibley & Ostafichuk, 2014); what if the

entire structure of the course was designed to promote engagement, problem-solving, critical thinking, and teamwork?

Team-Based Learning

Learning in groups has received mixed reviews from students (Felder & Brent, 1996), and can often times be thrown together by instructors with little consideration for research-based, best practice (Colbeck, Campbell, & Bjorklund, 2000). Advocates for group learning provide guidelines for establishing norms for effective learning groups, but are often ignored (Colbeck et al., 2000). In hopes that issues arising from 'haphazard' adoptions of group learning, many instructors at institutions of higher education have turned to Larry Michaelsen's Team-Based Learning (TBL) model.

TBL is a teaching method that relies on small group work, focuses on improving student's ability to apply course content, and is designed to improve learning (Michaelsen, Sweet, & Parmalee, 2011). This method was developed in response to a large enrollment in a business course in the late 1970's by Dr. Larry Michaelsen (Michaelsen & Sweet, 2011). Michaelsen's course grew from 40 students to 120 students, and he wanted to avoid lecturing as it was too passive a method for what he really wanted his students to be able to do. He noted the engagement in his smaller classes and wanted that to transition into his new, larger courses (Michaelsen & Sweet, 2011). In the world of business, Michaelsen noted the importance of group communication and wanted to emphasize that in this new method. He had utilized small group work in his smaller courses and noted the usefulness in allowing students to learn how to apply concepts and communicate effectively, versus simply learning about the course concepts (Michaelsen, Knight, & Fink, 2004).

Michaelsen tested out his new method by preparing a set of relevant articles/ documents for students to read before attending his class. He would then administer an individual test over the pre-reading material and the same test immediately after, but in teams (Michaelsen et al., 2011). Michaelsen noted the depth of discussion regarding course concepts when the students completed the test in their teams. Much of the items being discussed were items that would have been covered in a lecture format course (Michaelsen et al., 2004). Michaelsen began molding his idea and four main elements emerged as the foundation for TBL as a teaching method and include; 1) Properly formed and managed groups, 2) Student accountability for individual and group work, 3) Frequent immediate student feedback, 4) Assignments that promote both learning and team development (Michaelsen et al., 2011).

Michaelsen developed a sequence of learning activities in TBL that are repeated for each macro-unit of instruction in a given course. There are three phases to the sequence including; 1) Preparation, 2) Application, and 3) Assessment. The preparation phase includes students completing readings before class, and in class the students take the individual and team test (Michaelsen et al., 2004). Further, students are able to appeal questions from the team test, and then a brief, concentrated lecture (usually 15 minutes or less) is provided to correct any misinterpretations of course concepts. The appeals process allows students to point out any ambiguity in the pre-class readings or within the questions on the test. It is simply a method to engage students in the content and is not meant for students to dig for points (Michaelsen et al., 2004). Students then move into the application phase of TBL. This is the heart of TBL and where most of in-class time is spent. The groups are tasked with real-world problems that start off as simple, and build to more complex (Michaelsen & Sweet, 2012). An exam or culminating team project can be provided in the assessment phase of the sequence. This overall sequence is

followed for each major unit of instruction. Figure 1 depicts the sequence and phases of a typical TBL module.

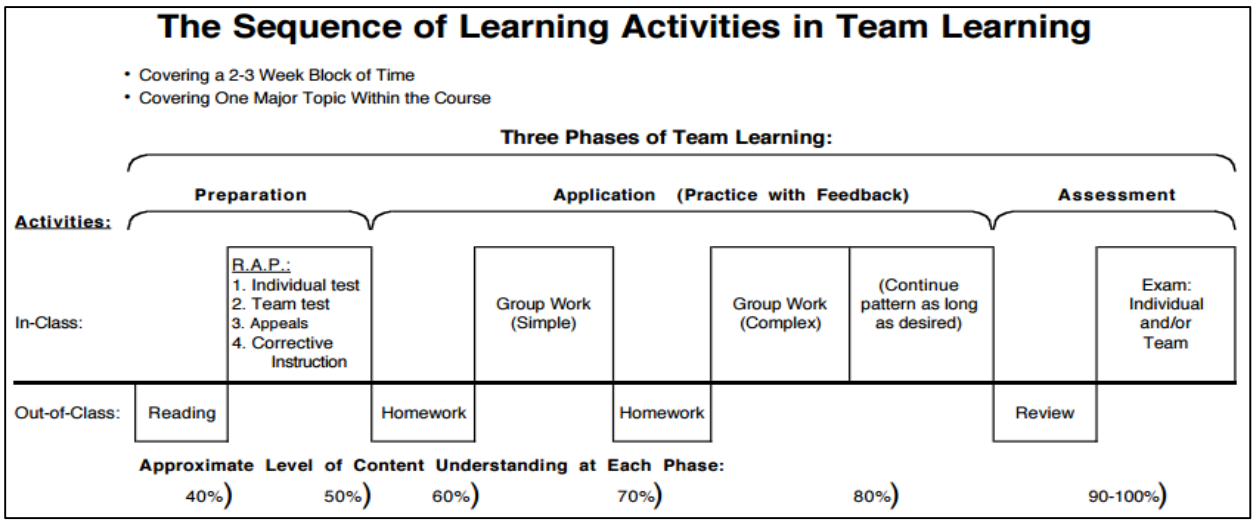

Figure 1. The Sequence of Learning Activities in Team-Based Learning
Reprinted from "Team-Based Learning: A Transformative Use of Small Groups," by L. K. Michaelsen, A. B. Knight, L. D. Fink, 2004, p. 11. Sterling, VA: Stylus Publishing. Copyright 2004 by Stylus Publishing. Reprinted with permission.

Utilizing TBL in its full form requires a strong commitment from the adopter. Sibley and Ostafichuk (2014) provide a great explanation and summary of TBL:

> TBL isn't a method that you sprinkle over your existing lecture course. It requires a complete rethinking of your overall course goals, a focused redevelopment of your course materials, and a commitment to take that adventuresome plunge into learner-centered teaching. There are powerful and important synergies between components of TBL; although it is possible to selectively implement some components of the model, considerable instructional power is lost. Many experienced TBL teachers think it is best to commit to the entire model to get the largest benefits and effects. Preparing for TBL is very different from preparing for a traditional course. In a traditional course, you may be able to dash off a lecture at the last minute, but with TBL's requirement for thoughtful

> integration of reading, getting your students ready using the Readiness Assurance, and engaging in classroom Application Activities, last minute prep will not work. (p. 6)

TBL has four essential elements that include: 1) properly formed and managed teams, 2) readiness assurance to ensure pre-class preparation, 3) learning how to apply course concepts, and 4) the importance of accountability (Sibley & Ostafichuk, 2014). These elements are slight revisions to the four principle pieces of TBL outlined by Michaelsen and Sweet (2011). Michaelsen and Sweet outlined proper teams, readiness assurance process at the beginning of each unit, application activities in 4-S format, and student-to-student peer evaluation.

Properly Formed and Managed Teams

TBL teams should be teacher-created and criterion-based to ensure diversity and adequate size (Sibley & Ostafichuk, 2014). The literature overwhelmingly supports the idea of teacher-created versus student self-selected teams; as the student selected teams underperform teacher-created teams (Brickell, Porter, Reynolds, & Cosgrove, 1994; Feichtner & Davis, 1984). Diversity in this sense encompasses previous experience (i.e., workplace experience or internships). Individual adopters of TBL can identify other important characteristics in their context that should be distributed amongst teams. Sibley and Ostafichuk (2014) discuss the need for "…heterogeneity in every team to ensure a wide range of skills, opinions, and personal experiences can come into play during team deliberations" (p. 66).

Readiness Assurance to Ensure Pre-Class Preparation

The Readiness Assurance Process (RAP) is used to ensure students prepare before attending class (Michaelsen et al., 2004). The unique structure of the RAP "…unleashes the power of social learning…" (Sibley & Ostafichuk, 2014). Students complete introductory

material before attending class. During class students complete Individual Readiness Assurance Test (IRAT) immediately followed by a Team Readiness Assurance Test (TRAT). The IRAT holds students accountable individually, while the TRAT hold students accountable to their teams. The TRAT, if administered using the Immediate Feedback Assessment Technique ("What is IF-AT?," n.d.), provides immediate feedback on incorrect answers and allows students to select until correct. If desired, partial credit can be awarded based on the number of attempts to select the correct answer (Michaelsen & Sweet, 2011). After completing of the TRAT, students may write a formal appeal that highlights ambiguity in the reading or a particular question (Sibley & Ostafichuk, 2014). The RAP is finalized by a short, clarifying lecture that addresses any misconceptions or troubling topics (Michaelsen et al., 2004).

Learning How to Apply Course Concepts

In most classrooms, students are left struggling to apply course concepts on their own time, in the form of homework (Bergmann & Sams, 2012). In TBL, the majority of in-class time is spent allowing teams to develop solutions for complex, real-world problems (Sibley & Ostafichuk, 2014). "A reality of TBL is that it requires students to become interdependent and function as a cohesive unit to make decisions and solve problems using course content" (Lane, 2012, p. 52). This application of content occurs during class and allows the student's access to the instructor if needed. It is important for the instructor to design these application exercises as close to the 4-S framework as possible. The 4-S frameworks ensures teams are working on the *same problem*, that it is a significant problem, it has a *specific choice*, and teams reveal their answers via a *simultaneous report* procedure (Sibley & Ostafichuk, 2014). After the teams have reported their answers, a class-wide discussion occurs, often resulting in a deeper understanding of the content as teams defend their selection (Michaelsen et al., 2004).

The Importance of Accountability

The accountability element is an important part of the TBL process. Students have likely had a negative experience in previous course that utilized learning groups of some sort and may react negatively when they realize that a TBL course relies on groups for the duration of the course (Sibley & Ostafichuk, 2014). In TBL courses, there are several layers of accountability. Accountability to the instructor occurs via the IRAT, while accountability to the team occurs via the TRAT and a formal peer evaluation process. Sibley and Ostafichuk (2014) stated, "We can try and motivate our students through extrinsic motivators such as grades, but intrinsic motivation activated by accountability to peers is even more powerful and effective…" (p. 14). The peer evaluation process may require some explanation as students may not be well versed in providing critical feedback to their peers (Lane, 2012).

Peer Evaluation

Providing peer feedback can stimulate critical thinking and engagement, as well as potentially reduce negative behaviors while reinforcing positive behaviors within the learning environment (Michaelsen & Sweet, 2011). The peer evaluation process in TBL, if implemented correctly, has the ability to reduce social loafing, strengthen preferred behaviors, as well as increase team cohesion (Michaelsen et al., 2004). Successful teams utilize the feedback from their peers to improve their assumptions of operation while individual students become aware of their interaction patterns through self-examination and the peer evaluations to improve (Lane, 2012). The peer evaluation process should include formative and summative feedback. Formative feedback should be used as a catalyst for team success. Summative feedback, while important, lacks the ability to address substantive issues that may hinder team cohesion. Sibley and Ostafichuk (2014) noted the importance of formative feedback with open and shared results.

This incorporates an additional layer of accountability for preparedness and participation within the team. The formative feedback process can address these issues throughout the course. Lane (2012) explains that the formative process is utilized to provide students information to "enhance group processes and team productivity" (p. 53) while the summative process provides instructors with outcome feedback and "…serves to guard against student social loafing while reducing grade inflation" (p. 53).

Designing effective peer evaluation procedures may be challenging. Students may worry about the ramifications of this course structure as it relates to their grades. Alleviating student concerns about grades is a critical step for student buy-in (Michaelsen et al., 2004). Lane (2012) denotes three phases in developing an effective formative feedback process including; 1) individual criteria identification, 2) generating consensus about team formative process feedback criteria, and 3) designing procedures for team formative process feedback.

Phase One: Individual Criteria Identification. Students are encouraged to reflect on their experiences in groups from previous courses and should consider positive and negative experiences with working in groups. From this reflection, the students should identify four or five of the issues they feel contribute most to the success or failure of their previous groups. The students then create a list of criteria they are comfortable evaluating their fellow team members on. This phase is completed individually. Common criteria include attendance, active participation, preparation, and communication (Lane, 2012; Michaelsen et al., 2004).

Phase Two: Generating Consensus about Team Formative Process Feedback Criteria. This phase should occur soon after the teams are established. The team should discuss the criteria each individual developed in phase one of the peer evaluation design process. The team should then begin working on creating a list of team criteria that is mutually agreed-upon. Lane (2012)

noted that much overlap between the individual lists usually exists. The team must decide the most important criteria that will be used to evaluate each other throughout the course. When students are involved in designing the peer evaluation procedures, they are more likely to buy-in (Lane, 2012; Michaelsen et al., 2004; Michaelsen & Sweet, 2011).

Phase Three: Designing Procedures for Team Formative Process Feedback. This phase allows students to develop the procedures in which they will utilize their mutually agreed-upon criteria to evaluate their peers. Lane (2012) suggested providing students with a series of questions to respond to while developing the procedures. This process allows students to develop meaningful measures of student contributions to the team based on their selected criteria. This process is implemented several times throughout the course and should inform the summative feedback, which is a component of the final grade. Discordantly, Sibley and Ostafichuk (2014) suggest the instructor should choose the peer evaluation method employed in a TBL-formatted course.

The benefits of TBL are well documented across several disciplines (McCubbins, Paulsen, & Anderson, in press). TBL's usage in medical education has been examined extensively (Dunaway, 2005; Haidet & Fecile, 2006; Haidet, O'Malley, & Richards, 2002; Hunt, Haidet, Coverdale, & Richards, 2003; Koles, Nelson, Stolfi, Parmelee, & DeStephen, 2005; Levine et al., 2004; Nieder, Parmelee, Stolfi, & Hudes, 2005; Ortega, Stanley, & Snavely, 2006; Parmelee, DeStephen, & Borges, 2009; Vasan, DeFouw, & Compton, 2009; and Vasan, DeFouw, & Holland, 2008). Other educational settings where TBL has been examined include business and marketing (Baldwin, Bedell, & Johnson, 1997; Hernandez, 2002; and Thackeray & Wheeler, 2006), law (Dana, 2007), psychiatry (Touchet & Coon, 2005), and accounting (Lancaster & Strand, 2001).

Many studies have noted an increase in student engagement in TBL formatted courses (Currey, Oldland, Considine, Glanville, & Story, 2015; Hazel, Heberle, McEwen, & Adams, 2013; Jacobson, 2011; Leisey, Mulcare, Comeford, & Kudrimoti, 2014; Mosher, 2013; Parmalee, DeStephen, & Borges, 2009; Vasan, DeFouw, & Compton, 2009). Specifically, Jacobson (2011) posited that students reported being more engaged and more satisfied with the layout of TBL courses. This may be a result of the clear expectations and design of TBL formatted courses. Mosher (2013) suggested that students are more prepared to collaborate with their fellow classmates. Being open to collaboration can aid in the development of positive team norms, which can ultimately result in higher achievement in courses. Parmalee, DeStephen, and Borges (2009) found that student engagement increased in a TBL formatted clinical course in a medical school. Students reported the growth of engagement of their team members as their experience in TBL continued throughout their program. TBL adopters also espouse the promotion and development of other domain-independent skills (soft skills) such as communication, problem solving, and leadership skills in TBL formatted courses (Samarasekera, Nayak, Yeo, & Gwee, 2014). Samarasekera, Nayak, Yeo, & Gwee (2014) also concluded that students enjoyed TBL sessions and that the learning that occurs during these sessions is effective.

As colleges of agriculture and higher education institutions push to promote engaging, student-centered courses, TBL is a viable option as an instructional strategy; as previous research has reported an increase in student engagement (Haidet, O'Malley, & Richards, 2002; Dana, 2007; Levine et al., 2004). The TBL method is particularly appealing to applied disciplines. TBL is attractive to those in the medical and business management field because the emphasis is on being able perform specific tasks (L. K. Michaelsen, personal communication, July 1, 2014). In

other words, the emphasis is on mastering a specific skill, which can only occur through content mastery. The instructors' purpose is better served in being present for students as they struggle with solving complex problems versus when they are being introduced to the content (Conner, Stripling, Blythe, Roberts & Stedman, 2014). Gaining practical farm management experience on a farming operation is the purpose of AgEdS 450 (Murray, 1945), which pairs well with the purposeful design of TBL courses.

As a form of active learning, TBL is not immune to the three barriers affecting the implementation of active learning techniques as outlined by Hains and Smith (2012). However, Michaelsen and Sweet (2011) provide strategies for addressing all three of the barrier categories (i.e., individual, administration, and student) and expected benefits to instructors and students. Concerning the faculty (individual) barrier, Michaelsen and Sweet (2011) posit that faculty members seldom have to worry about student attendance or preparation, stronger student-teacher relationships are formed, and student-teacher interaction is increased because the students are engaged in the process. In regards to the administration barrier, Michaelsen and Sweet (2011) note the cost effectiveness of TBL. It can be utilized in large courses and across academic programs, and allows for meaningful team relations, which limit the possibility of student complaints to the administration. Lastly, related to the student barrier, students can expect to be more engaged with the course content, value working in teams, and improved performance within the course (Michaelsen & Sweet, 2011).

Table 1 depicts the parallels found in the Flipping Principles (Jeffries, 2015) and TBL components (Michaelsen et al., 2004).

Table 1
Parallels of the Flipped Course and Team-Based Learning Model

Flipping Principles	TBL Component
Knowledge transfer moved outside of the class	Pre-class preparation
Application of the content in class	Application Exercises
Peer teaching	Peer discussions during the TRAT Intra- and Inter-team discussions during application exercises.
Contextual learning	Application exercises- Should be relevant and real-world.
Assessment reinforces learning	IRAT and TRAT

Social Network Analysis

Social science research often focuses on the individual, and "it neglects the *social* part of behavior; the part that is concerned with the ways individuals interact and the influence they have on one another" (Freeman, 2004, p. 1). Social Network Analysis (SNA) is defined as "an approach and set of techniques used to study the exchange of resources among actors (i.e., individuals, groups, or organizations). One such resource is information" (Haythornhwaite, 1996, p. 323). SNA is useful in examining the flow of information as a resource within an educational setting and in examining collaboration levels within a course.

In order to understand the complexities that can surface from studies of social networks, an understanding of basic terminology and practices is necessary. Table 2 identifies some basic terminology that can be found throughout the SNA literature.

Table 2
Definitions of Social Network Analysis Concepts and Measures

Concepts and Measures	Definition
Dyad	Two objects connected by some sort of relationship[a]
Triad	Network of three objects connected by relationships[a]
Size	The number of actors/nodes in a network[b]
Density	The proportion of all possible ties actually present in a network[b]
Reachability	Existence of a set of connections where every actor is connected to another, regardless of path length[b]
Connectedness	The proportion of pairs of nodes that can reach one another by a pathway of any length[c]
Geodesic Distance	Number of relations in the shortest pathway that connects two actors[b]
Eccentricity	An actor's largest geodesic distance[b]
Diameter	Largest eccentricity present in a network[b]
Compactness	A measure that weighs paths connecting nodes inversely by their length[c]
Reciprocity	Proportion of reciprocated ties to total number of ties[c]
Transitivity	Measure of the occurrence of transitive or intransitive triads[c]
Clustering	A set of actors judged to be similar on the basis of relational data[b]
Robustness	A measure of how many nodes need to be removed in order to disconnect the network[c]
Degree	Number of connections[c]
Indegree	Measure of ties sent from other actors to a target actor in directed networks[c]
Outdegree	Number of ties sent from target actors to other actors in directed networks[c]
Cohesion	The extent that actors within a network are connected[b]

Note: Common terms utilized in analyzing social networks. [a]Kadushin (2012); [b]Hanneman and Riddle (2011); [c]Borgatti et al. (2013).

The simplest network contains two actors, and a relationship that links them (Kadushin, 2012). Several types of relationships between dyads exist which include; simple, directed, symmetric, and relationship through intermediary (Kadushin, 2012). A simple relationship can be described as two actors in one location. The relationship is not directed in any way. A directed relationship describes a situation where actor one likes actor two. Symmetric relationships occur when actor one likes actor two and vice versa. Relationships through an intermediary is best explained when information flows from one actor to another, and eventually is passed on to an

additional actor. The relationship is directional but is not reciprocal (Kadushin, 2012). Figure 2 displays the various types of relationships in SNA.

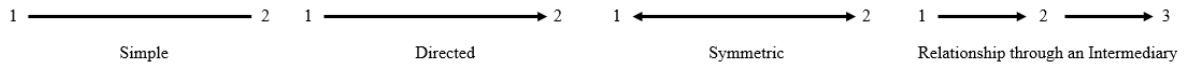

Figure 2. Types of Relationships in Social Network Analysis. Adapted from "Understanding Social Networks," by C. Kadushin, 2012.

The paucity of available literature concerning SNA in agricultural education demands attention. While examining undergraduate and graduate acceptance of technology in relation to social networking sites, Murphrey, Rutherford, Doerfert, Edgar, and Edgar (2012) found that students do not recognize the value of social network sites within the realm of their education. While not a true application of SNA, Murphrey et al.'s (2012) findings could be attributed to the students lack of understanding of the importance of social networks and the flow of information in general. Functional networks are important in the educational setting, and should be examined to determine the effects of varied network development (Baldwin et al., 1997).

In regards to examining social networks within Agricultural Education, Roberts, Murphy, and Edgar (2010) explored the interactions among student teachers during their student teaching experience. Roberts et al. (2010) found that the networks did not support defining the group of student teachers as close knit, although they did engage in interaction with each other. This is unfortunate as Roberts et al. (2010) noted the importance of social interaction for learning, especially during a student teaching experience. However, the study by Roberts et al. (2010) examined the network at the end of an experience, which doesn't allow for examining the growth of the network over time. This was realized and provided a suggestion to examine the formation, growth/change, and possible interventions to strengthen the overall network.

Tichy, Tushman, and Fombrun (1979) describe several considerations when examining social networks. The first is transactional content and is defined by what is exchanged between two or more individuals. The exchange could be information, affect, or a proximity relation (in the same group, on the same team, etc.). The second consideration is the nature of the links, or the quality of the relationship between two individuals. The third consideration in social network analysis is the structural characteristics of the network itself. Structural characteristics refers to the network overall and any patterns that may emerge between actors within a set boundary.

Tichy et al. (1979) further break down the three components in SNA by describing characteristics of each. Within the transactional content component, there are four main types of exchange between actors and include; 1) expression of affect, 2) influence attempt, 3) exchange of information, and 4) exchange of goods or services. A network can be formed for each type of exchange, that "…may or may not overlap and an individual's position in the networks may vary" (Tichy et al., 1979, p. 509).

When describing the nature of the links, the terms intensity, reciprocity, clarity of expectations, and multiplexity are often used (Tichy et al., 1979). Intensity refers to the strength of the relation between two or more actors. This can be indicated by individuals honoring obligations to other actors (Mitchell, 1969) or by the number of points of contacts between two actors (Tichy et al., 1979). Reciprocity refers to two individuals reporting a relationship with each other (e.g., Actor A reports a tie to Actor B, and Actor B reports a tie with Actor A). Clarity of expectations is "the degree to which individuals agree about appropriate behavior in their relations to one another" (Tichy et al., p. 509). Multiplexity is used to describe how individuals may play many roles within an organization.

When conducting analyses on networks, the structural characteristics can be divided into the following four categories: external network, total internal network, clusters within the network, and individuals as special nodes within the network. The external network structural characteristic seeks to examine ties beyond the boundary of the network, which is beyond the scope of this dissertation and will not be addressed. The total internal network seeks to examine how actors within a given boundary are linked together. Clusters within the network describes areas within a network in which actors are more closely linked with one another. These clusters could be a result of "…formally prescribed work groups, emergent coalitions, or cliques" (Tichy et al., 1979, p. 509). Individuals as special nodes within the network allows researchers to realize that not all individuals within a network are equally important. This is conceptualized by labeling nodes as liaisons, gatekeepers, and isolates (Tichy et al., 1979). Liaisons link areas within the network to other areas of the network. Gatekeepers may serve as a link from within the network to outside entities. Isolates are actors who are not connected within the network in anyway. While isolates are not desired in an educational application of SNA, there are several other factors that need to be considered when examining the networks that are formed.

Baldwin et al. (1997) suggest that an individual's embeddedness within a social network is an important factor to be considered in SNA research. Embeddedness, measured in closeness centrality measures, refers to how connected an actor is with other actors, as this can play a critical role in the types of resources (tangible or intangible) the actor has access to (Brass, 1992). The closeness centrality measure is the "ease of access to others" in a network (Burkhardt & Brass, 1990, p. 113). In an educational setting, this may be the sharing of critical information from one actor to many other actors within the network.

Crunkilton et al. (1997), discussed the importance of oral communication in a capstone course, and it is also a crucial component in TBL (Michaelsen et al., 2004). SNA is being utilized to examine the communication and draw inferences on how the information flows through said network. “Just as roads structure the flow of resources between cities, relationships structure the flow of resources in a social environment” (Haythornthwaite, 1996, p. 324). Baldwin et al. (1997) posit that communication networks are indicative of instrumental relations that occur within organizations. That is, communication networks formed within the educational setting can provide insight into effective teaching practices. Communication in a team setting is also heavily discussed in the TBL literature (Michaelsen et al., 2004; Michaelsen et al., 2008).

Theoretical and Conceptual Frameworks

This dissertation was grounded in a number of theoretical and conceptual frameworks. The teaching and learning process is a multifaceted task, and research regarding such a topic should be viewed in several ways. The theories outlined in this dissertation were chosen so that the effectiveness of TBL’s implementation into a capstone course could be fully explained.

Transformative Learning Theory (Mezirow, 2000)

Transformative Learning Theory (Mezirow, 2000) served as the principal theoretical framework for this dissertation. Mezirow (2000) posited that much of what individuals know and believe is dependent upon the context in which they are embedded. The context, as Mezirow (2000) explains, are generally embedded in biographical, cultural, or historical contexts of individuals. Mezirow (2000) further stated the importance of developing decision-making skills by analyzing individual experiences, assessing the specific context of the experience, and working to establish informed meaning and justification for resulting interpretations and opinions in adult education. In adult learning, emphasis must be placed on “contextual

understanding, critical reflection on assumptions, and validating meaning by assessing reason" (Mezirow, 2000, p. 3).

The development of Transformative Learning Theory (Mezirow, 2000) "was influenced by the concept of *paradigm*, made popular as factor in the development of scientific though by Thomas Kuhn (1962), and that of *conscientization*, described by Paulo Freire in his influential *Pedagogy of the Oppressed* (1970)" (p. *xiii*). In its later stages of development, Critical Theory and its emphasis on critical reflection, as well as the work by Jurgen Habermas (1984) which extended the work of Critical Theory, played important influential roles in Transformative Learning Theory (Mezirow, 2000). Transformative Learning Theory is comprised of three common themes which include "…the centrality of the experience, critical reflection, and rational discourse in the process of meaning structure and transformation" (Taylor, 1998, p. 8). In regards to centrality of the experience, Taylor (1998) espouses that student's experiences are socially constructed, which allows them to be deconstructed and acted upon. Mezirow (1995) noted the beginning of and the subject matter for transformative learning is the learners' experience.

Transformative Learning Theory is grounded in the nature of human communication (Taylor, 2007). Taylor (1998) opined that Tennant's (1991) description of a learner's experience offers an incredible deal of congruency with transformative learning. Tennant (1991) espoused that learners share experiences and establish a common knowledge base. From that knowledge base, learners construct meaning through personal reflection and discussion with others; however, the meaning constructed by an individual is subject to scrutiny. "The teacher may consciously try to disrupt the learner's world view and stimulate uncertainty, ambiguity, and doubt in learners about previously taken-for-granted interpretations of experiences" (p. 197).

This process encourages critical reflection among the learner. Critical reflection allows the learner to question their assumptions and beliefs that are deeply rooted in past experiences, while rational discourse is the medium that transformative learning is promoted and developed through (Taylor, 1998).

Mezirow (2000) noted seven factors that must be present in order for learners to fully immerse themselves in discourse and included:

- More accurate and complete information
- Freedom from coercion and distorting self-perception
- Openness to alternative points of view: empathy and concern about how others think and feel
- The ability to weigh evidence and assess arguments objectively
- Greater awareness of the context of ideas and, more critically, reflectiveness of assumptions, including their own
- An equal opportunity to participate in the various roles of discourse
- Willingness to seek understanding and agreement and to accept a resulting best judgment as a test of validity until new perspectives, evidence, or arguments are encountered and validated through discourse as yielding a better judgment (p. 14)

Transformative Learning Theory (Mezirow, 2000) seeks to transform frames of reference that are likely based on less reliable assumptions. A frame of reference, as explained by Mezirow (2000), is the structure of individual assumptions that form meaning. “It selectively shapes and delimits perception, cognition, feelings, and disposition by predisposing our intentions, expectations, and purposes” (Mezirow, 2000, p. 16).

Mezirow (2000) defined adult educators as those who do not indoctrinate, but create opportunities to shift their authority over the learning environment to the learners in order to become collaborative learners. It is necessary to eliminate the traditional power relationships that exist between teachers and learners, so that the learners may become more autonomous within the learning environment (Mezirow, 2000). These notions align with the TBL model in several ways. TBL is focused on allowing students to apply course content and to take control of their learning (Michaelsen et al., 2004). The TBL model itself could be viewed as a disorienting dilemma to students as they may be used to traditional content delivery methods, such as lectures or other teacher-centered instructional methods (Hains & Smith, 2012).

Student Involvement Theory (Astin, 1999)

Astin's (1999) Student Involvement Theory (SIT) also served as a theoretical framework for this study. SIT is grounded in decades of research elucidating that involvement references the "…quantity and quality of the physical and psychological energy students invest in the college experience" (Astin, 1999, p. 528). Astin's (1975) longitudinal work on student persistence as it related to involvement was the basis for development of SIT. Astin noted that lack of involvement is often signaled by passivity. Furthermore, Astin (1999) explained that the behavioral aspect of student's involvement is critical. In other words, what the student does in the learning environment signifies involvement. When concentrating efforts on instructional approaches–those that nurture student involvement–higher education institutions can expect significant benefits (Smith, Sheppard, Johnson, & Johnson, 2005). These instructional approaches involve students in the learning process. Astin (1989) developed five postulates in the early stages of SIT:

1. Involvement refers to the investment of physical and psychological energy in various objects. The objects may be highly generalized (the student experience) or highly specific (preparing for a chemistry examination).
2. Regardless of its object, involvement occurs along a continuum; that is, different students manifest different degrees of involvement in a given object, and the same student manifests different degrees of involvement in different objects at different times.
3. Involvement has both quantitative and qualitative features. The extent of a student's involvement in academic work, for instance, can be measured quantitatively (how many hours the student spends studying) and qualitatively (whether the student reviews and comprehends reading assignments or simply stares at the textbook and daydreams).
4. The amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of student involvement in that program.
5. The effectiveness of any educational policy or practice is directly related to the capacity of that policy or practice to increase student involvement (p. 519).

Social Learning Theory (Bandura, 1977) and Social Constructivism (Vygotsky, 1978)

Bandura's (1977) Social Learning Theory (SLT) and Vygotsky's (1978) social constructivism also guided parts of this dissertation. The notion that personal, behavioral, and environmental factors are "…interlocking determinants of each other" (p. 10) in SLT highlights the various aspects that can be modified in attempts to aid student development. Initial focus within the SLT framework focused on behaviors of the individuals, while social constructivism

focused mainly on cognition. Both theorists discuss the important of interaction with others for individual development. Vygotsky (1978) espoused that for learner development, interaction with a more capable individual was necessary. Similarly, Bandura (1977) noted the importance of observational learning. Without the possibility to learn through modeling, costly errors in the performance of a given task would occur. Bandura (1977) stated, "…behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action" (p. 22). Both perspectives provide sound guidance for the development of instructional approaches; the need to foster interaction within the learning environment is important for the cognitive and behavioral development of students.

Action Research

Action research cannot be classified as a single discipline and has emerged as an approach to research from various disciplines (Brydon-Miller, Greenwood, & Maguire, 2009). Dewey's reflexive thinking as well as Lewin's use of action research spurred the early conceptualizations of action research as is known today (Kuhne & Quigley, 1997). Kuhne and Quigley provide an operational definition of action research:

> "Based on their theories, action research can be understood as an approach to problem posing and problem solving that proceeds through four distinct processes: planning, acting, observing, and reflecting" (p. 24).

Kemmis and McTaggart (1984) espoused that action research is a method that puts "…new ideas into practice as a means of increasing knowledge about curriculum, teaching, and learning" (p. 24). This process leads to an improvement within the learning environment and provides sound

justification for the adoption of particular practices (Kuhne & Quigley, 1997). Action research is realized in four basic, cyclical steps that include; planning, acting, observing, and reflecting.

Action researchers seek to effect change leading to knowledge generation and stakeholder empowerment (Huang, 2010). Action is the true means to legitimate understanding, and "…theory without practice is not theory but speculation" (Huang, 2010, p. 93). Huang further explains action research through the writing of a doctoral student who compares it to Dewey and Kolb's definition of experiential learning. The idea is that the researcher learns by participating in the process, is a novel way to integrate scholarship and impact, and can serve as a complement to traditional research within the social sciences (Huang, 2010). Action researchers are changed through their experiences via reflection, and are a mix of scholar and activist (Brydon-Miller, Greenwood, & Maguire, 2010).

Researcher Positionality Statement. It should be noted that I am a strong supporter of flipped classrooms, specifically, team-based learning. I was first introduced to team-based learning in the spring of 2014. After several discussions with individuals who have a vested interest in AgEdS 450, it was decided to revise the structure to a TBL format. The flip to TBL format took a considerable amount of time. The financial burden associated with the major time investment was supported by departmental funds as well as funds from an individual within the department. I have attended three international TBL conferences, am involved in the Iowa State University Center for Excellence in Learning and Teaching Faculty Learning Community on TBL, as well as in the TBL Trainer Consultant program. I have presented on TBL at the local, regional, national, and international level. I have also worked with secondary agriculture teachers across the United States in flipping courses to TBL format. I have also assisted three individuals at the

postsecondary level in their transition from traditional instructional approaches to the TBL method. I have a previous publication concerning TBL and have been an invited contributor to the TBL newsletter. My experience and commitment to the TBL instructional approach uniquely positions me to contribute to the existing gap in literature as it relates to agricultural education and TBL's implementation. While I am qualified to conduct such a study, bias is inherently a concern. Accordingly, the appropriate steps were taken to reduce the introduction of bias. The three areas chosen to examine TBL's effectiveness in AgEdS 450 were planned with appropriate and accepted measures to control for bias.

Conceptual Framework

Conceptually, this study can be visualized through the Taxonomy of Learning Activities Model (TLAM) (Roberts, Stripling, & Estepp, 2010). The TLAM depicts a continuum within the learning environment that moves from teacher-centered activities to student-centered activities. As an educator that follows a progressive philosophy, my goal is to move to more autonomous students within the learning environment.

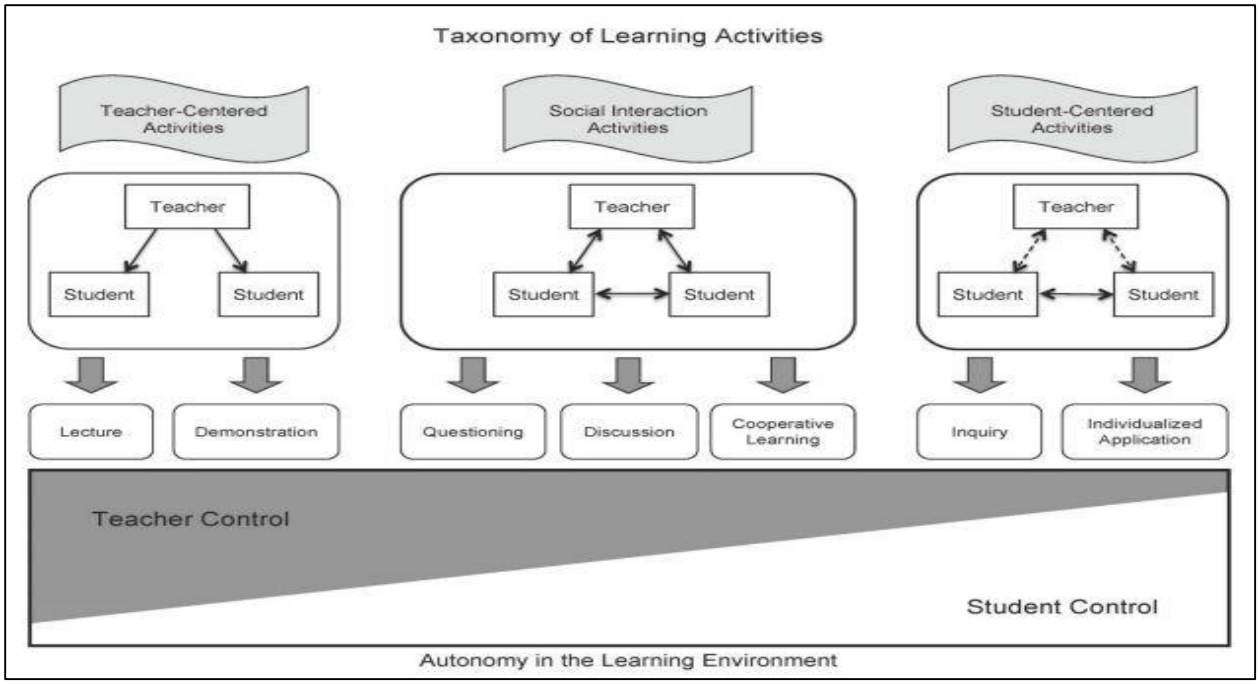

Figure 3. Taxonomy of Learning Activities Model (Roberts, Stripling, & Estepp, 2010)

Table 3, as developed by McCubbins, Paulsen, and Anderson (in press), shows the parallels between TBL and TLAM activities.

Table 3

Parallels between the taxonomy of learning activities and TBL activities

TLA (Roberts et al., 2010)	TBL Activity
Teacher-Centered Activities	Preparation
Lecture	Out-of-class reading (or video)
Demonstration	Out-of-class reading (or video)
Social Interaction Activities	Preparation/ Application
Questioning	Individual and team tests
Discussion	Corrective instruction, application activities
Cooperative Learning	Team tests, appeals, application activities
Student-Centered Activities	Application/ Assessment
Inquiry	Individual application exercises, review
Individual Application	Individual application exercises, individual exam/ project

Summary

This chapter provides an overview of the objectives of the study, pertinent literature, and theoretical frameworks utilized in guiding this study. TBL, a student-centered teaching method was recently implemented into the AgEdS 450 capstone course. As such, this study sought to examine TBL's effectiveness in regard to transforming the learning environment into an active space that fosters student–to-student interaction. The theoretical frameworks highlight the importance of involvement and social interaction within the learning environment as students analyze their beliefs and assumptions and try to make meaning of new knowledge and experiences. Chapter III will provide the methods employed to address each research objective.

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CHAPTER III. METHODS

This chapter discusses the methods and procedures utilized to collect and analyze the data and address the research objectives. General methods for the dissertation in its entirety are explained and followed by the methods and procedures employed for each of the three studies. Chapter I outlined the problem, purpose and objectives of this study while Chapter II explored the literature that undergird the theoretical basis for this study. The purpose of this study was to determine the effectiveness of the Team Based Learning (TBL) teaching method in the AgEdS 450, Farm Management and Operation, a capstone course in the Department of Agricultural Education and Studies at Iowa State University. In order to accomplish the purpose of this study, the following research objectives were developed:

1. Research Objective One
    a. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development prior to completing the TBL formatted AgEdS 450 course.
    b. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
    c. Determine if there were changes in student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
    d. Determine areas of improvement that would enhance TBL's implementation as perceived by students.

2. Research Objective Two
    a. Determine the importance of engagement-specific activities within the AgEdS 450 course as reported by the instructional team–instructor, teaching assistant, and farm operator.
    b. Determine the frequency of student participation in engagement-specific activities within the AgEdS 450 course.
    c. Determine correlations between perceived importance and frequency of engagement-specific activities within the AgEdS 450 course.
3. Research Objective Three
    a. What does a collaboration network map look like in a team-based learning formatted course?
    b. Does the collaboration network map change over the course of the semester?
    c. Did the collaboration network become more inclusive?

Participants and Demographics

A convenience sample of all students enrolled in the AgEdS 450 course (N = 121) during the fall 2015 (n = 61) and the spring 2016 (n = 60) semester were purposefully selected as the target population for the three objectives of this study. Students enrolled in the AgEdS 450 course were taught in a TBL formatted manner, and examining the effectiveness of TBL was the main priority. The course consisted of a combined lecture and a split laboratory section, in which the students meet on the farm once per week.

Instruments and Data Collection

Due to the nature of this study, three different instruments were utilized in an attempt to robustly measure the effectiveness of TBL in a capstone course. Approval from ISU's

Institutional Review Board (IRB) was received prior to collecting data (See Appendices A, B, and C). The instrument utilized to address each objective is discussed in the subsequent text.

Research Objective One

In order to measure the impact a TBL formatted course had on student perceptions of their experience, research objective three was addressed through a non-experimental, pre-test/post-test design. The pre-test/post-test design allowed changes in student perceptions to be measured.

The Student Learning Experiences (SLE) survey developed by Bickelhaupt and Dorius (2016) was utilized to measure student perceptions of their experience in previous group projects and the TBL format. The instrument consisted of 35 Likert-type questions and two open-ended questions for feedback on the structure of the course. The SLE is comprised of three constructs (Likert scales), representing three learning domains, and included; 1) beliefs and attitudes about learning, 2) motivation to learn, and 3) professional development through critical thinking. Two of the 35 items were classified as independent measures as they did not situate within the established constructs. These items asked about the team working well together and about being provided the appropriate resources for the course. The researchers utilized Qualtrics, a web-based survey program, to collect student perceptions within the three learning domains. A pretest–posttest design was utilized to measure change in students' perceptions within three learning domains. The pretest and posttest instruments varied only in how the questions were targeted. The pretest questions focused on previous experience while the posttest focused on the specific experience within the TBL formatted course. For example, the pretest asked "*When a theory, interpretation, or conclusion has been presented in other courses or in previous readings, I try to decide if there is good supporting evidence*," where the posttest was stated as,

"*When a theory, interpretation, or conclusion was presented in class or in the readings, I tried to decide if there was good supporting evidence*."

Bickelhaupt and Dorius (2016) established face and content validity by utilizing a panel of experts in survey design and TBL. The instrument was pilot tested with students (n = 1039) enrolled in TBL formatted courses at Iowa State University to measure reliability (Bickelhaupt & Dorius, 2016). After the pilot study, focus groups were conducted with students to further enhance face validity. Following the suggestions of Urdan (2010), the pilot study resulted in construct reliability coefficients deemed acceptable ($\alpha = 0.84 – 0.92$). Additionally, McCubbins, Paulsen, and Anderson (in press) utilized the posttest instrument and deemed the resulting reliability coefficients ($\alpha = 0.73 – 0.91$) acceptable. Instruments in the present study were collected from respondents in the fall 2015 (n = 56) and spring of 2016 (n = 54) for a 91.6% response rate (n = 110). Pretest and posttest construct reliability coefficients were deemed acceptable (Table 1).

Table 1
Reliability Coefficients

	Post hoc Cronbach's Alpha Observed		Established Posttest Cronbach's Alpha
Construct	Pretest	Posttest	(McCubbins et al., in press)
Beliefs and Attitudes about Learning	0.97	0.95	0.91
Professional Development through Critical Thinking	0.96	0.93	0.84
Motivation to Learn	0.95	0.75	0.73

Demographic and academic attributes of students were obtained from the Office of the Registrar at Iowa State University. To describe students' academic attributes, university-specific terminology was used, and is described as follows. Semester credit hours were defined as the number of credit hours in which the student was enrolled during the study. Semester grade point average (GPA) was calculated for the semester in which the study occurred. Cumulative credit

hours were defined as the total hours received at Iowa State, and cumulative GPA was calculated from Iowa State credits only. Total hours was the sum of all credits including those transferred in from other institutions. Method of entry refers to direct enrollment from high school or transfer from an outside institution. Descriptive statistics were used to describe the student demographic data. To address research objective one and two, measures of central tendency and variability were calculated in SPSS for each construct. For objective three, paired-samples *t*-tests were utilized to determine the significance of differences in student perceptions based upon enrollment in the TBL formatted AgEdS 450 course.

Qualitative data from the two open-ended items were analyzed following Guest, MacQueen, and Namey's (2012) Applied Thematic Analysis (ATA) procedures. ATA is an amalgamation of components from other "…theoretical and methodological camp[s]…" (Guest et al., p.15) that are most useful in an applied context. The applied nature of the study allowed the qualitative data analysis to be conducted through structural coding procedures. Structural coding was "used to identify the structure imposed on a qualitative data set by the research questions and design" (Guest et al., 2012, p. 55).

The present study contained two structural topics (themes) relating to the two open-ended questions; a) suggestions for improvement, and b) general comments. Data bound within these two themes were analyzed through ATA coding procedures, and a codebook was created. The use of intercoder agreement procedures and an external reviewer were employed to strengthen the validity of the qualitative analysis. Intercoder agreement was established through the analysis of segments of the text with the developed codebook by two individuals associated with the research study and one individual not associated with the study (external review). Subjective assessment procedures were employed to resolve "discordant coding" (Guest et al., p. 89)

between the researchers and an individual not associated with the study. In the case of a discrepancy, the coders discussed the reasoning, arrived at a solution, and revised the codebook as appropriate. The entire data analysis process was documented in order to establish an audit trail. Verbatim quotes from the participants are utilized throughout as they should be, according to Guest et al., "…pivotal parts of the narrative" (p. 95). Student numbers, in lieu of pseudonyms, were randomly assigned within Qualtrics after the pre- and posttests were matched. The structure imposed on the qualitative data allowed the researchers to focus the narratives to gather relevant information concerning recommendations for improving the course experience through the participant's voices.

In regard to educational degree pursuit, the results represent a homogenous sample. Care should be exercised when extrapolating results beyond the students enrolled in AgEdS 450. However, data gleaned from this study may provide useful insight for instructors of other courses within colleges of agriculture regarding student perceptions towards TBL.

Research Objective Two

To address research objective two, a non-experimental, descriptive research design was employed. The purpose of this objective was to measure student engagement in a TBL formatted capstone course. AgEdS 450 is a capstone course for Agricultural Studies majors at Iowa State University and, as its primary outcome, is to provide students with real-world experiences grounded in the tenets of Crunkilton et al.'s (1997) capstone course components. The course was recently revised to a TBL structure. TBL is a student-centered teaching method that emphasizes small group work and the application of content (Michaelsen, Knight, & Fink, 2004). Students enrolled in the course met for a combined lecture period on campus, and were split into two laboratory sections that met on the farm once per week (Paulsen, 2010). The Classroom Survey

of Student Engagement (CLASSE), derived from the National Survey of Student Engagement (NSSE) (Kuh, 2004), is a two-part instrument "that compares faculty expectations with what students report experiencing in a class" (Ouimet & Smallwood, 2005, p. 13). The NSSE instrument, based on a research foundation concerning student engagement (Coates, 2009; Kuh, 2004), provides a holistic view of an institution's level of student engagement.

While the NSSE focuses on institutional level engagement, the CLASSE focuses on classroom-level engagement. CLASSE is also not grade specific, whereas the NSSE is typically targeted to first-year and senior students (Ouimet, 2011). The engagement indicators remain constant within both the NSSE and CLASSE; the major alteration is the wording to be class specific versus institution-wide (Ouimet & Smallwood, 2005). An example from NSSE is: *During the current school year, about how often have you done the following? Asked questions or contributed to course discussions in other ways.* The response options include *Very Often, Often*, *Sometimes*, and *Never*. The CLASSE focuses on classroom specific behaviors. An example from CLASSE is: *So far this semester, how often have you done each of the following in your [COURSE NAME] class? Asked questions during your [COURSE NAME] class. Contributed to a class discussion that occurred in [COURSE NAME] class*. Response options for these items are *Never, 1 or 2 times, 3 to 5 times,* and *More than 5 times*. The subtle changes are necessary in order to determine what is actually happening at the course level (Ouimet & Smallwood, 2005; Reid, 2012; Smallwood & Ouimet, 2009). In developing the CLASSE, Ouimet and Smallwood focused on items from NSSE that were based on Chickering and Gamson's (1987) Seven Principles for Good Practice in Undergraduate Education (Ouimet, 2011). The CLASSE Student instrument asked students to reflect on their behavior regarding specific course activities. Students indicated the frequency of participation in specific activities

that were classified as indicators of engagement. Examples of engagement indicators within the CLASSE Student instrument included participating in class discussions, working with other students to complete projects, presenting to the class, applying concepts to practical problems, amount of time preparing for class, and the number of absences during the semester. Additionally, the CLASSE Faculty instrument asked faculty to rate the value they place on the same engagement-related activities. Both surveys included 41 items among five constructs, including: 1) engagement activities (n = 19), 2) cognitive skills (n = 5), 3) other educational practices (n = 10), 4) class atmosphere (n = 4), and 5) demographics (n = 3). The student version of the instrument included an open-ended section which allowed students the opportunity to provide additional comments.

CLASSE is a localized engagement survey derived from NSSE, thusly it is governed by the NSSE as well as The Trustees of Indiana University. Therefore, the first step in utilizing the CLASSE required determining the institutional eligibility. This was achieved by reviewing the most recent administration of the NSSE at Iowa State University. To be eligible to utilize the CLASSE, an institution must have administered the NSSE within the last three years. At the time of examining eligibility, Iowa State was deemed eligible due to NSSE participation in 2011, 2013, and 2016 ("Participating Institutions," 2016). The CLASSE Student was administered to all students enrolled in AgEdS 450 during the fall 2015 (N = 61) and spring (N = 60). The fall administration yielded an 88.5% (n = 54) response rate and the spring iteration yielded an 86.6% (n = 52) response rate. Accounting for both semesters of administration, the total response rate was 87.6% (n = 106). No efforts beyond the initial administration were attempted based on a response rate greater than 85% (Lindner, Murphy, & Briers, 2001). Additionally, the applied purpose of the data was to inform practice within the given course, an 87.6% response rate was

deemed acceptable by the researchers. The CLASSE Faculty instrument was administered to all individuals involved in planning, delivering, or approving curriculum (instructor, farm operator, and the professor-in-charge) within the course (N = 3) and yielded a 100% response rate prior to the start of the 16-week course. Measures of central tendency (i.e., means and standard deviations) for the CLASSE Student and CLASSE Faculty responses were calculated with SPSS 19.0. The means for the CLASSE Student instrument were then compared to CLASSE Faculty instrument means in a 2x2 quadrant analysis (Ouimet, 2011; Smallwood, 2010). Figure 1 depicts the quadrant descriptions and their corresponding statistical thresholds.

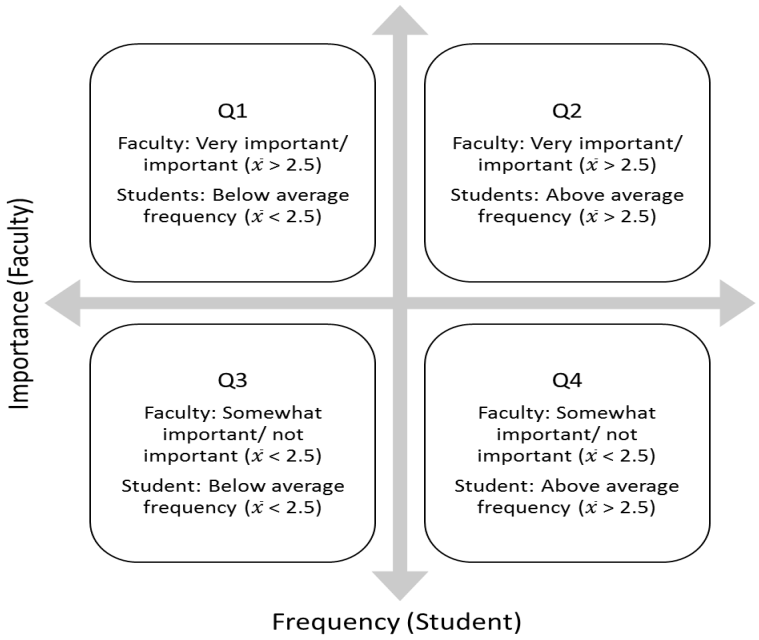

Figure 1. Diagram of the 2x2 Quadrant Analysis. Adapted from "Assessment Measures: CLASSE–The Class-Level Survey of Student Engagement," by J. A. Ouimet and R. A. Smallwood, 2005, Assessment Update, 17, p. 15. Copyright 2005 by John Wiley & Sons, Inc.

Items in the top left quadrant (Q1) are rated very important or important by faculty but student responses indicate a below average frequency of participation in activities related to student engagement. Items in the top right quadrant (Q2) are rated as very important or important by faculty and reported by students as having above average participation in those engagement

related activities. The lower left quadrant (Q3) contains items instructors rated as somewhat important or not important with students reporting below average participation in those activities. Quadrant four (Q4), the lower right quadrant, contains items rated somewhat important or not important by faculty and had above average participation per student reports. Q1 and Q4 are known as *misses*, as they show discrepancies between faculty rated importance and student frequencies; while Q2 and Q3 are known as *hits*, which show congruency between what faculty reports compared to what students reported doing.

Bempechat and Shernoff (2012) noted the difficulty that arises in attempting to measure student engagement through observer ratings, as it isn't always an observable characteristic. Thus, student self-reported data was utilized based on its practicality and its ability to measure non-observable indicators of engagement (Mandernach, 2015). Instructors of the course studied are the primary beneficiaries of the results, however results from this study could also provide valuable insight to engagement levels in a flipped, TBL-formatted course. It should be noted that the data presented here is representative of a homogenous population in regards to educational degree pursuit. Additionally, no specific data is available regarding the psychometric properties of CLASSE. According to Carle, Jaffee, and Miller (2009), the limited between-survey differences (NSSE and CLASSE) should result in similar reliability coefficients noted by Kuh (2001) which ranged from 0.85 to 0.90.

Research Objective Three

Research objective three sought to explore and describe the development of, and potential growth of social networks in a TBL formatted capstone course. SNA studies are often developed in three stages (Kapucu, Yuldashev, Demiroz, & Arslan, 2010; Scott & Carrington, 2011; Springer & de Steiguer, 2011). This study, employing a non-experimental design, followed the

aforementioned stages and included; 1) identifying the network, 2) collecting social interaction data, and 3) analyzing the resulting data. A full network, position-based approach, as outline by Laumann, Marsden, and Prensky (1983), was utilized to define the boundary of the network. Since the target population were those enrolled in the AgEdS 450 course during the fall 2015 (n = 61) and spring 2016 (n = 60) semester, a census was conducted and served as the boundary definition of the network for each semester. Network diagrams were created for each time point of data collection for each semester. The resulting networks were analyzed independently as the interest was focused on the growth and development of the networks within the TBL formatted course.

Instrumentation

Data were collected on a researcher-created, paper-based, sociometric questionnaire (Moreno, 1953). The survey included selected demographic data (i.e., team number, age, lab section, major, class status, and committee), a class roster, and instructions on filling out the instrument. The class roster was distributed amongst three rows, in alphabetical order. Participants were instructed to identify only students with whom they had collaboratively worked, and to rate that level of collaboration. Previous relationships were not of interest in the current study, therefore students were instructed to only rate the collaboration with other students during this specific course. The levels of collaboration were summarized on a five-point scale ranging from no collaboration to high-level collaboration. In order to assess the growth and development of any resulting network, a semester-long multipoint assessment was conducted with the sociometric survey. The sociometric survey was distributed after the first week of the course, at the mid-point, and again during the last week of the 16-week semester. This was

repeated for both fall 2015 and spring 2016 semesters. Response rates for the fall 2015 (n = 61) and spring 2016 semester (n = 60) were 100% (N = 121).

Figure 2 depicts the student response options for reporting collaboration with other students. *No collaboration* was defined as not seeking information or input for various assignments or projects during the course. *Low level collaboration* was described as seeking minimal information or input from others for assignments or projects while *high level collaboration* was defined by significant contributions of information or input from others for completion of assignments or projects. These definitions were reiterated at each point in the data collection process.

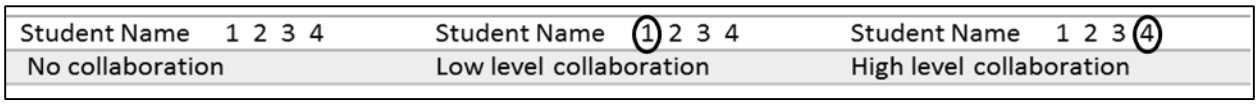

Figure 2. Response options for the AgEdS 450 sociometric questionnaire

Data Management

Before data analysis could be completed, reported data had to be coded, and input into a social network matrix. Data management included alpha-numerically coding each individual student, and creating a full matrix including all reported relational data (i.e., collaboration). The first row and column identified the node and the information within the cells indicated a relation. The relational information can be binary (i.e., 1s and 0s) or valued (i.e., 0, 1, 2…), where binary data may indicate a relation or not and valued data may indicate a level of relations. For example, binary data could indicate that node A reports node B is a friend and would be indicated with a 1, while valued data could be measured by how often actors interact with others or how strongly they rate their friendship and be indicated with a predetermined measure (e.g., 1 = acquaintances, 2 = close friends, 3 = best friends). Symmetric matrices are those where the lower left section of the matrix mirrors the top right portion ($x_{ij} = x_{ji}$), while directed ties utilize

an asymmetric matrix where $x_{i\,j}$ could equal $x_{j\,i}$ but does not have to (Borgatti, Everett, & Johnson, 2013). Figure 3 shows an example of a non-reflexive network matrix (Borgatti et al., 2013). For this study, the data were dichotomized before analyses were conducted for interpretability purposes. Descriptive statistics for explaining networks were performed in UCINET (Borgatti, Everett, & Freeman, 2002). Specific measures calculated included; density, average degree, average geodesic distance, reciprocity, transitivity, blocks, cutpoints, diameter, and number of ties (actually present and total possible). Network visualizations were diagramed with NetDraw (Borgatti, 2002). All procedures performed contribute to explaining the networks that emerged from each time point of relational data collected.

		Participants							
		A01	A02	A03	A04	A05	A06	A07	…
Participants	A01		0	1	1	0	0	0	
	A02	0		0	1	0	0	1	
	A03	1	1		0	0	0	0	
	A04	0	1	1		1	0	0	
	A05	0	0	0	0		0	1	
	A06	0	1	0	0	0		0	
	A07	0	1	0	1	1	0		
	…								

Figure 3. Sample adjacency matrix. Adapted from "Analyzing Social Networks," by S. P. Borgatti, M. G. Everett, and J. C. Johnson, 2013.

A separate matrix was created for the attribute data collected. The rows represented each actor while the columns represented specific attributes of each node. Figure 4 illustrates an attribute matrix and its components.

		Attributes						
		Team #	Age	Section	Major	Status	Committee	...
Participants	A01	1	22	1	1	3	1	
	A02	2	21	1	1	3	2	
	A03	3	25	1	1	4	1	
	A04	4	22	1	1	4	3	
	A05	5	21	1	1	3	5	
	A06	6	23	2	1	4	9	
	A07	7	21	2	1	4	10	
	...							

Figure 4. Sample attribute matrix. Adapted from "Analyzing Social Networks," by S. P. Borgatti, M. G. Everett, and J. C. Johnson, 2013.

As noted in Perry, Paulsen, and Retallick (2015), the AgEdS 450 course structure is unique. Perry et al. contended that the course structure offers ideal conditions for experimental research design because the course has two laboratory sections. This can be argued for small-scale research. However, the entire class met in an on-campus facility for the lecture portion of the course on Tuesdays, which would introduce a serious threat of diffusion. Laboratory sections met separately on Wednesdays and Thursdays each week and consisted of roughly half of the students in each laboratory section. In an effort to promote collaboration as well as handle increasing enrollment, TBL was couched alongside the capstone course tenets expounded by Crunkilton et al. (1997). Figure 5 displays how the teams and committees were separated.

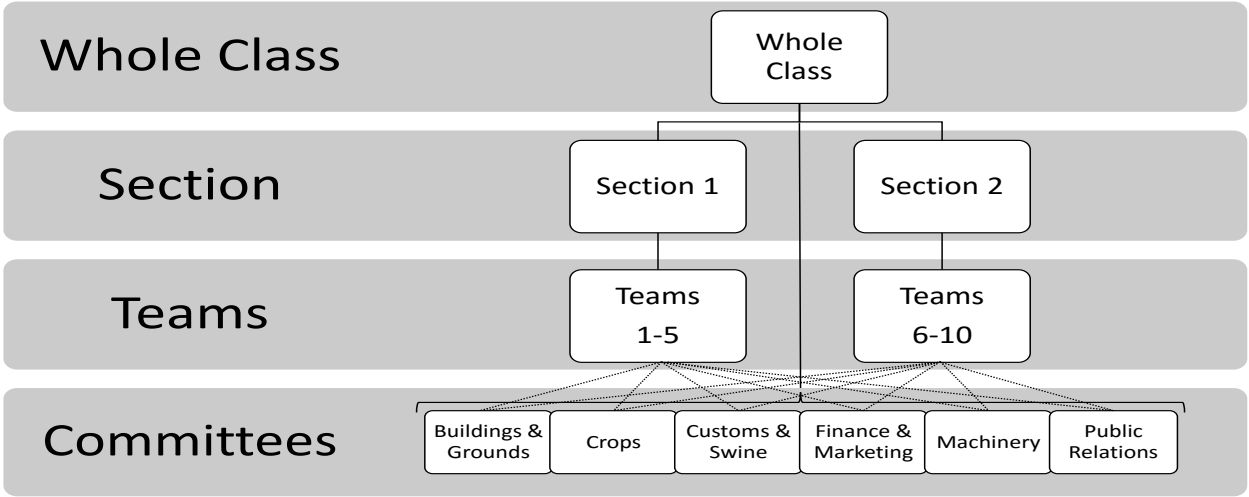

Figure 5. AgEdS 450 structure with teams and committees.

Each semester had 10 teams of five to seven students. Teams were selected via criterion-based measures in order to ensure a distribution of academic resources (e.g., academic performance, work experience, major, etc.). The teams were contained within sections, meaning teams one through five were in section one and team six through ten were in section two. To encourage the formation of multiple networks and to promote exposure to several perspectives, teams determined committee representation. The committees represented the various enterprises found on the AgEdS 450 farm. Committees were distributed across sections. This layout allowed for half of each committee to be present on any given laboratory day. Importantly, teams made decisions regarding the management and operation of the farm while committees actually researched and carried out any decisions made. That is, if the teams decided to market grain, the finance and marketing committee would then be responsible for ensuring the execution of the contract.

Limitations

Data were collected from a homogenous sample in regards to educational degree pursuit (Bachelor of Science in Agriculture Studies). Care should be exercised in generalizing to outside populations. The data will still offer insight to faculty and administrators within colleges of agriculture for consideration of the adoption of TBL. Findings will offer evidence regarding TBL's impact on student engagement, student's preference for learner-centered teaching strategies, and the social networks that result from a team-based course.

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CHAPTER IV. EXAMINING STUDENT PERCEPTIONS OF THEIR EXPERIENCE IN A TBL FORMATTED CAPSTONE COURSE

A paper prepared for submission to the *Journal of Agricultural Education.*

OP McCubbins, Thomas H. Paulsen, Ryan G. Anderson

Abstract

While shown to be less effective than active learning strategies, traditional methods of content delivery in post-secondary classrooms are the most prominent. Flipped classrooms, an example of an active learning approach, have been shown to be effective in long-term student outcomes. Team-Based Learning (TBL), a specific application of the flipped approach, has been linked to an increase in student performance, engagement, and satisfaction. TBL emphasizes the application of content knowledge through structured problem solving and decision making activities. The capstone farm management course, Agricultural Education and Studies 450, at Iowa State University was recently restructured to implement TBL. This course revision sought to emphasize the development of skills necessary for success in an evolving workforce. The purpose of this study was to examine student perceptions concerning their attitudes and beliefs about learning, their motivation to learn, and their professional development through critical thinking. Pretest and posttest measures were compared and showed statistically significant increases across all three areas. These results offer valuable insight for the adoption of student-centered teaching methods, specifically TBL. Further examination of this teaching method compared to traditional teaching methods is warranted and recommended.

Keywords: team-based learning; flipped learning, active learning, capstone course

Introduction and Literature Review

Lecturing and other teacher-centered instructional approaches are frequently utilized in secondary and post-secondary settings (Balschweid, Knobloch, & Hains, 2014; Smith, Rayfield, & McKim, 2015). In a national study of secondary agricultural education programs concerning the effectiveness of instructional activities, Smith, Rayfield, and McKim (2015) found that a majority of agricultural education teachers devoted most of their class time to lecturing. Puzzlingly, those same teachers reported the effectiveness of lecturing to be relatively low (Smith et al., 2015). Balschweid, Knobloch, and Hains (2014) noted many faculty members perceive teaching as lecturing and that sentiment is "…embedded in their schema" (p. 163). Based on this preconception it is difficult for faculty members to apperceive other methods of instruction. Whittington and Newcomb (1993) recommended that "[p]rofessors make conscientious changes in their current teaching methodology to reach the cognitive levels to which they aspire for their instruction" (p. 61). Implementing active learning techniques, more specifically a flipped classroom model, may prove useful in improving cognitive levels reached and eliminate the sole reliance on lecture methods.

Flipped classrooms have garnered much attention at all levels of academic instruction in recent years (Barkley, 2015; Bishop & Verleger, 2013). The increased traction of flipped learning in higher education may be explained by a focused effort by instructors to reach higher cognitive levels in student learning processes, increase student engagement, and ensure the development of skills desired by employers (Espey, 2010; Lamm, Carter, & Melendez, 2014; Tucker, 2012). The flipped classroom has also received considerable attention within agricultural education (Barkley, 2015; Conner et al., 2014a; Conner et al., 2014b; Gardner, 2012; McCubbins, Paulsen, & Anderson, in press). While the popularity may be relatively new, flipped

classrooms have existed for several decades in some manner or another (Chen, Wang, Kinshuk, & Chen, 2014). When implementing the flipped approach to teaching, instructors provide basic, introductory content to students prior to a face-to-face class session so that class time is available for meaningful learning activities (Enfield, 2013). Enfield (2013) suggested group discussions, demonstrations, projects, and team building were advantages of the flipped classroom. In the flipped model, students interact with peers and the instructor as they construct knowledge during class time (Bergmann & Sams, 2012; Missildine, Fountain, Summers, & Gosselin, 2013; Kong, 2014). The foundation of the flipped classroom is comprised of constructivist ideologies paired with behaviorist principles; two learning theories that were once viewed as incongruous (Bishop & Verleger, 2013). The material in which students engage prior to class, usually through readings or recorded lectures, fit under the behaviorist principle of direct instruction while the activities carried out during class sessions align with constructivist's views (Bishop & Verleger, 2013).

One of the earlier documentations of the flipped model in the postsecondary setting occurred at the University of Oklahoma in the late 1970s and was called Team-Based Learning (TBL) (Michaelsen, Knight, & Fink, 2004; Sibley & Ostafichuk, 2014). As noted by McCubbins, Paulsen, and Anderson (in press), a consensus on the origins of the flipped learning model is elusive. TBL has been defined as an active teaching method that emphasizes small-group work and the application of content; in stark contrast with traditional methods of passive content reception (Michaelsen, Sweet, & Parmalee, 2011). TBL, when developed, was reportedly an amalgam of mastery learning and cooperative learning principles (Michaelsen, 1992). Though similar to cooperative learning, important characteristics set TBL apart (Michaelsen & Sweet, 2011). Sibley and Ostafichuk (2014) outlined the four elements essential to the TBL method as:

1) properly formed and managed teams, 2) readiness assurance process to ensure preclass preparation (RAP), 3) learning how to apply course concepts, and 4) the importance of accountability. The teams should consist of five to seven students and be determined by the instructor based on set criteria to ensure heterogeneity (Michaelsen et al., 2004; Michaelsen et al., 2011; Sibley & Ostafichuk, 2014). The RAP includes four steps: 1) preclass preparation, 2) individual readiness assurance test (IRAT), 3) team readiness assurance test (TRAT), and 4) appeals (Michaelsen & Sweet, 2011).

Preclass preparation requires students to engage in the instructor-organized course content via readings, videos, and other forms of media prior to attending class. During the first class session of a module, students are assessed individually via the IRAT, and again immediately following via a TRAT (Michaelsen et al., 2004). The TRAT "…unleashes the power of social learning and immediate focused feedback…" (Sibley & Ostafichuk, 2014, p. 11). This is accomplished by allowing students to discuss the questions and through immediate feedback on their answer selection. Immediate feedback is possible by administering the TRAT via an Immediate Feedback Assessment Technique (IFAT) card ("What is the IF-AT?", n.d.). For appeals, students are able to provide a written, scholarly argument to recapture points on missed questions. Students must provide an argumentative statement and supporting evidence from the preclass preparation materials (Michaelsen et al., 2004; Michaelsen & Sweet, 2011; Michaelsen et al., 2011). Following the RAP, a targeted, clarifying instruction session is conducted. Clarifying instruction is geared toward the concepts that may remain unclear to the students (Michaelsen et al., 2004). Remaining class sessions within the module are for students to apply course concepts via application exercises. Application exercises are designed to present

students with a significant problem grounded in a real-world scenario where students work together to make a decision (Michaelsen et al., 2004).

The final component highlighted by Sibley and Ostafichuk (2014) is the importance of accountability. The importance is solidified as students determine the grade-weights for the entire course across three categories: 1) individual performance, 2) team performance, and 3) peer evaluation (Michaelsen et al., 2004). Students are held accountable via the IRAT, TRAT, application exercises, and finally through graded peer evaluations. This teaching approach requires "…a shift in the role of the instructor from dispenser of information to manager of a learning process" (Michaelsen, 1992, p.109).

Despite the lack of consensus on when or where flipped learning began, parallels exist between TBL principles and flipped learning principles. Table 1 depicts the parallels found in the Flipping Principles (Jeffries, 2015) and TBL components (Michaelsen et al., 2004).

Table 1
Parallels of the Flipped Course and Team-Based Learning Model

Flipping Principles	TBL Component
Knowledge transfer moved outside of the class	Pre-class preparation
Application of the content in class	Application Exercises
Peer teaching	Peer discussions during the TRAT Intra- and Inter-team discussions during application exercises.
Contextual learning	Application exercises- Should be relevant and real-world.
Assessment reinforces learning	IRAT and TRAT

TBL has been touted as an effective means for improving student performance (Baldwin, Bedell, & Johnson, 1997; Johnson & Lee, 2008) and engagement (Balwan et al., 2015; Kelly et al., 2005). However, implementing TBL requires a focused redevelopment of an entire course's structure (Sibley & Ostafichuk, 2014). Support for the transition from a teacher-centered method to a student-centered method is important. Addo-Attuah (2011) noted the criticality of buy-in

from faculty, students, and administration for successful implementation of TBL. That buy-in can often be difficult to achieve when deciding to adopt student-centered instructional practices (Hains & Smith, 2012). Hains and Smith (2012) noted that instructors can be resistant to adopt student-centered teaching methods; administrators may resist the adoption to seemingly allow faculty to focus on research; and students may combat the transition because they are not attuned to the transition of authority within the classroom. Similarly, students may not value working with other individuals based on previous, negative experiences in team settings (Espey, 2010), adding to the difficulty of student buy-in. Conversely, Espey (2010) found that the value students place on working with others increases significantly after a semester of TBL exposure.

Setting

Agricultural Education and Studies 450 (AgEdS 450)–Farm Management and Operation–is a capstone course for students seeking a Bachelor of Science degree in Agricultural Studies from Iowa State University. AgEdS 450 was developed in order to provide students with the opportunity to gain practical farm management skills before leaving college (Murray, 1945). AgEdS 450 is structured around Crunkilton, Cepica, and Fluker's (1997) capstone course framework, defined as "a planned learning experience requiring students to synthesize previously learned subject matter content and to integrate new information into their knowledge base for solving simulated or real world problems" (p. 3). Crunkilton et al. posited that a true capstone experience "…focuses on complete integration of fragmented disciplinary knowledge, permitting students to bring meaningful closure to their academic experiences" (p. 3) and "…provides students with a rich contextual frame of reference for furthering connection between theory and practice often initiated earlier in their academic experiences" (p. 4). A capstone course should ease a student's transition into a chosen career or entry into further academic study (Crunkilton

et al.). Through the utilization of a student-managed farm and the capstone course framework, students engage in collaborative research to analyze and synthesize information to make informed decisions in a real-world setting (Paulsen, 2010; Perry, Paulsen, & Retallick, 2015). AgEdS 450 has utilized a committee structure to aid in the development of problem-solving and decision-making skills (Vogel & Steiner, 2004). In the TBL format for AgEdS 450 at the time of this study, teams and committees were used simultaneously. The teams were selected using a criterion-based process to ensure heterogeneity while the committee members were elected from within each team. This nesting of committees within teams allowed for two separate learning networks to form. In this format, teams made decisions for the farm and committees carried out those decisions. For example, if a team decided to recommend the purchase a specific brand of seed for planting, they would present necessary information to all other teams. Then if the team's recommendation was approved for adoption, the crops committee would be responsible for ordering, paying for, and acquiring the seed. Figure 1 depicts the course structure and how teams and committee are distributed.

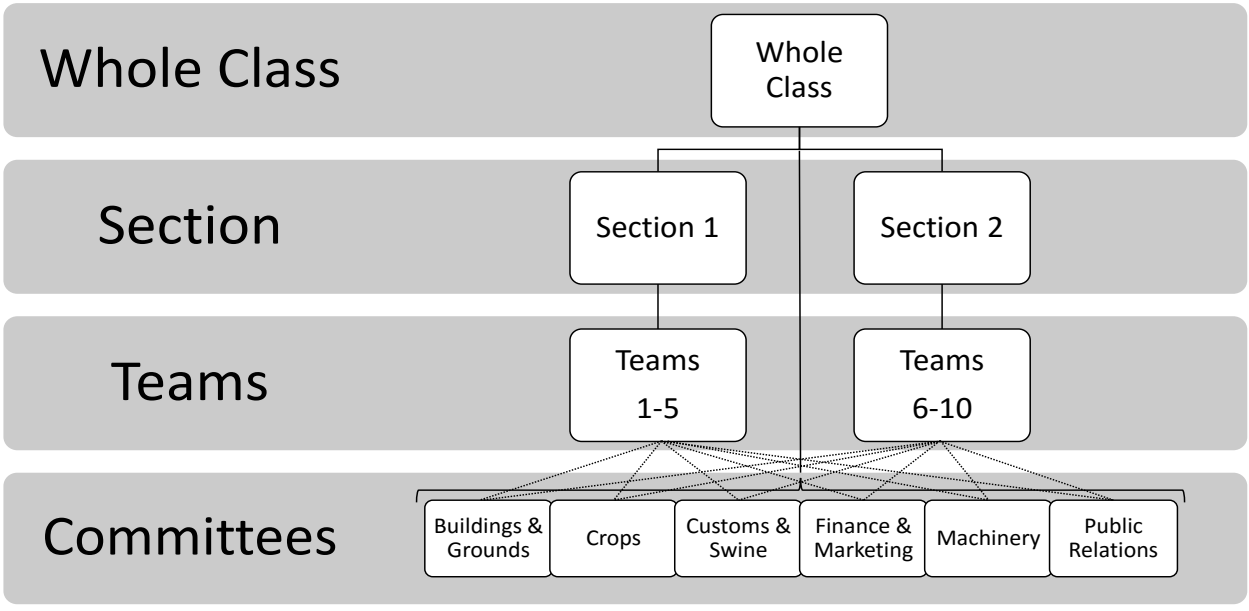

Figure 1. AgEdS 450 structure with teams and committees.

The conceptualization of the entire AgEdS 450 course in TBL format is depicted in Figure 2. Students arrive in the capstone course with fragmented disciplinary knowledge and through the structured activities and emphasis on applying content knowledge in a team-based setting; students integrate that new and old knowledge in solving practical problems. The border of the model displays the skills that are emphasized throughout the course activities, which includes problem solving, decision-making, critical thinking, and communication. The center of the model contains the core components of the TBL framework, beginning with preclass preparation and progressing to the assessment phase. The top half of the center portion of the model outlines the activities that are conducted by the AgEdS 450 committees, while the bottom half outlines the activities completed by teams.

The team and committee activities occur simultaneously throughout the semester. Teams engage with the course content before arriving to class (preclass preparation) where they are tested individually and as a team (readiness assurance) over the course content. Teams are then tasked with solving real-world problems through simple and complex application exercises (application of knowledge) before being assessed in the form of projects or exams (assessment). This process is repeated for each module in the course; five to seven modules are recommended depending on individual course needs (Michaelsen et al., 2004).

Committees prepare for class by identifying several preparation activities, which may include: crop scouting, farm safety and building assessments, or equipment maintenance review. This information is included in official business meeting reports. Committees apply their knowledge by carrying out committee responsibilities, and providing information to teams in order to make farm management decisions. Decisions made during the official business meetings

are then carried out by the appropriate committee. Assessment of the committees is completed through written reports. This process is repeated as often as necessary for each committee.

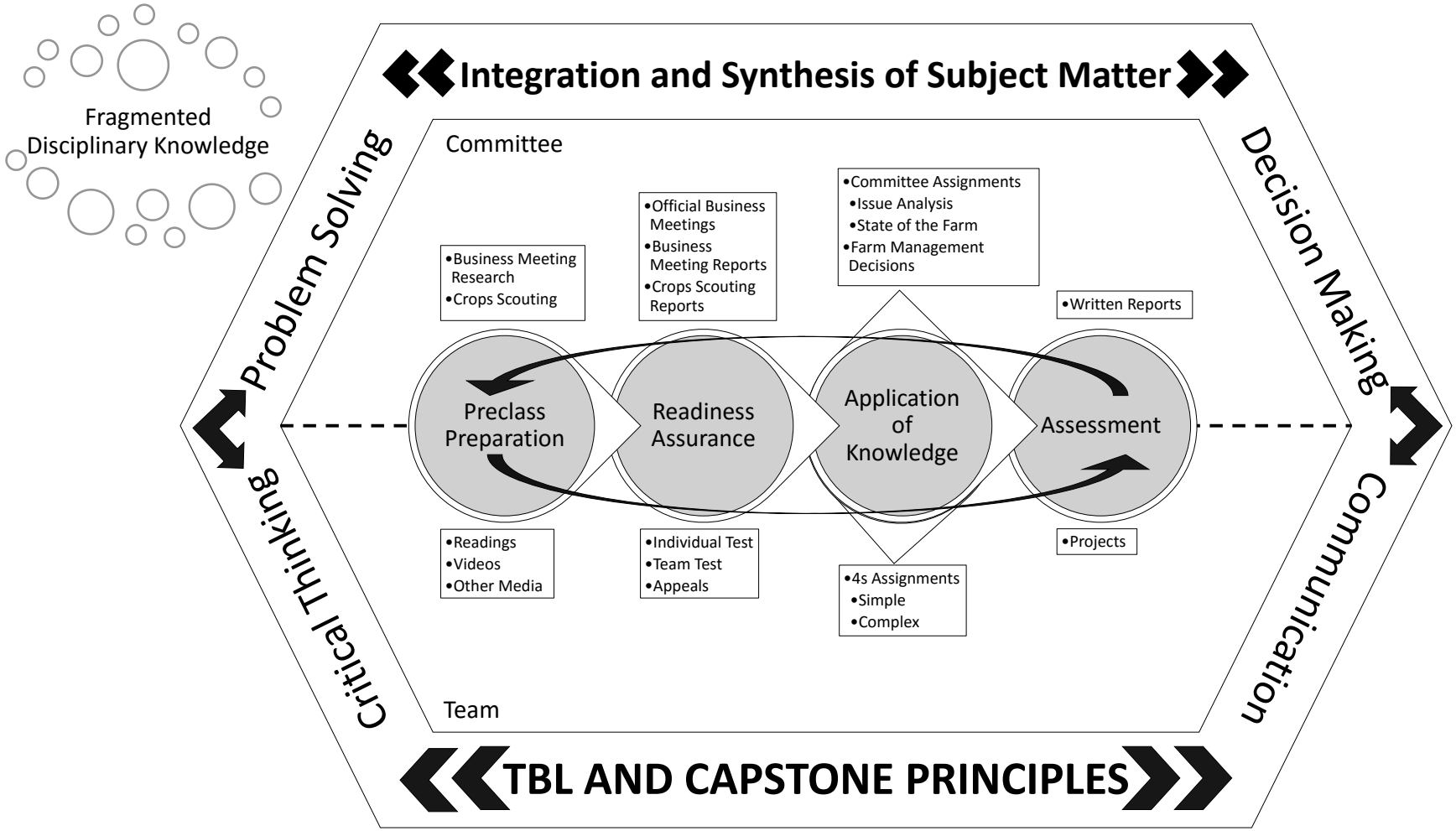

Figure 2. Model of the integration of Team-Based Learning and the capstone course framework. Adapted from "Handbook on Implementing Capstone Courses in Colleges of Agriculture," by J. R. Crunkilton, M. J. Cepica, and P. L. Fluker, 1997; "Team-Based Learning Instructional Activity Sequence," by L. K. Michaelsen, A. B. Knight, and L. D. Fink, 2004, Team-Based Learning: A Transformative Use of Small Groups in College Teaching, p. 37. Copyright 2004 by Stylus Publishing.

Theoretical/ Conceptual Framework

The transference of authority within the learning environment may aid in the development of transferable skills for workplace success. Students may consider assuming the responsibility for their own learning as a disorienting dilemma. Mezirow (2000) stated that a disorienting dilemma is an essential component to transformative learning. Accordingly, Mezirow's (2000) Transformative Learning Theory served as the theoretical framework for this study. Mezirow (2000) posited that much of what individuals know and believe is dependent upon the context. The context, as Mezirow (2000) explains, is generally embedded in biographical, cultural, or historical contexts of individuals. Mezirow (2000) further identified the importance of developing decision-making skills by analyzing individual experiences, assessing the specific context of the experience, and working to establish informed meaning and justification for resulting interpretations and opinions in adult education. In adult learning, emphasis must be placed on "contextual understanding, critical reflection on assumptions, and validating meaning by assessing reason" (Mezirow, 2000, p. 3).

The development of Transformative Learning Theory (Mezirow, 2000) "was influenced by the concept of *paradigm*, made popular as a factor in the development of scientific thought by Thomas Kuhn (1962), and that of *conscientization*, described by Paulo Freire in his influential *Pedagogy of the Oppressed* (1970)" (p. *xiii*). In its later stages of development, Critical Theory and its emphasis on critical reflection, as well as the work by Jurgen Habermas (1984) which extended the work of Critical Theory, played important influential roles in Transformative Learning Theory (Mezirow, 2000). Transformative Learning Theory is comprised of three common themes which include "…the centrality of the experience, critical reflection, and rational discourse in the process of meaning structure and transformation" (Taylor, 1998, p. 8).

In regard to centrality of the experience, Taylor (1998) espoused that student's experiences are socially constructed, which allows them to be deconstructed and acted upon. Mezirow (1995) noted the beginning of and the subject matter for transformative learning is the learner's experience. Transformative Learning Theory is grounded in the nature of human communication (Taylor, 2007). Taylor (1998) opined that Tennant's (1991) description of a learner's experience offers an incredible deal of congruency with transformative learning. Tennant (1991) stated:

> [Shared] learning experiences establish a common base from which each learner constructs meaning through personal reflection and group discussion… The meanings that learners attach to their experiences may be subjected to critical scrutiny. The teacher may consciously try to disrupt the learner's world view and stimulate uncertainty, ambiguity, and doubt in learners about previously taken-for-granted interpretations of experiences (p. 197).

Critical reflection allows the learner to question assumptions and beliefs that are deeply rooted in their past experiences; while rational discourse is the medium through which transformative learning is promoted and developed (Taylor, 1998).

Mezirow (2000) noted seven factors which must be present in order for learners to fully immerse themselves in rational discourse and included; 1) accurate and complete information, 2) freedom from coercion and distorting self-perception, 3) openness to alternative points of view (empathy and concern about how others think and feel), 4) the ability to weigh evidence and assess arguments objectively, 5) greater awareness of the context of ideas and, more critically, reflectiveness of assumptions, including their own, 6) an equal opportunity to participate in the various roles of discourse, and 7) willingness to seek understanding and agreement and to accept

a resulting best judgment as a test of validity until new perspectives, evidence, or arguments are encountered and validated through discourse as yielding a better judgment (p. 14).

Transformative Learning Theory (Mezirow, 2000) seeks to transform frames of reference that are likely based on less reliable assumptions. A frame of reference, as explained by Mezirow (2000), is the structure of individual assumptions that form meaning. "It selectively shapes and delimits perception, cognition, feelings, and disposition by predisposing our intentions, expectations, and purposes" (Mezirow, 2000, p. 16). Mezirow (2000) defined adult educators as those who do not indoctrinate, but create opportunities to shift their authority over the learning environment. This transition allows passive learners to become collaborative learners, but the traditional power relationships that exist between teachers and learners must be eliminated. When this transition occurs, it allows the learners to become more autonomous within the learning environment (Mezirow, 2000). Many of these notions expounded by Mezirow seemingly align with the TBL format and capstone course framework.

Though originally created as a model for outlining the learning activities within a teaching methods course, the Taxonomy of Learning Activities (TLA) (Roberts, Stripling, & Estepp, 2010) is useful in conceptualizing a transition from teacher-centered activities to more autonomous, student-centered activities, such as with the adoption of TBL. The TLA, depicted in Figure 3, allows instructors to visualize the continuum of learning activities, beginning with teacher-centered activities and moving toward student-centered activities. This transition of learning activities from teacher as authority to autonomous student learners aligns with Mezirow's (2000) description of educators within Transformative Learning Theory. Mezirow (2000) espoused that educators must strive to transition authority within the learning environment to their students, and when feasible, to create a collaborative learning environment

where students become self-directed learners. In regards to the TLA model, teacher-centered activities include lecturing and demonstration; social interaction activities include questioning, discussion, and cooperative learning; and student-centered activities utilize inquiry and individualized applications (Roberts et al., 2010). The theoretical and conceptual frameworks which served as a foundation for this study were operationalized through the implementation of the TBL teaching method in a capstone course. TBL aims to develop high performing teams, capable of applying course content to solve complex, real-world problems while holding themselves and their peers accountable for learning the material (Michaelsen et al., 2004; Michaelsen et al., 2011).

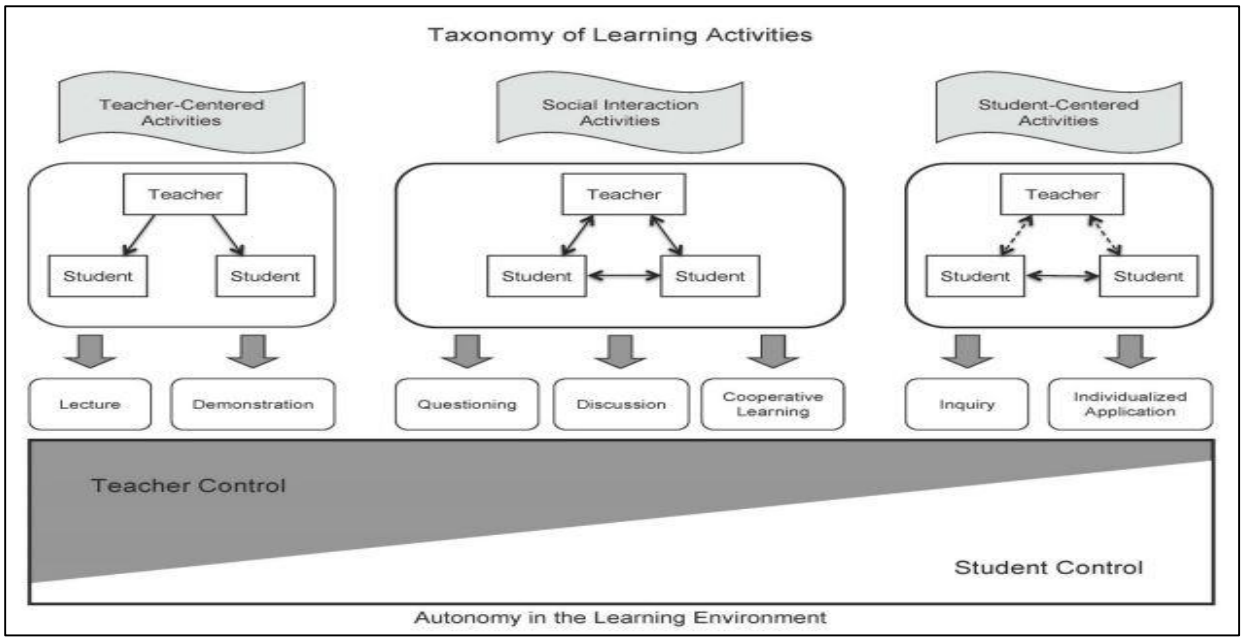

Figure 3. Taxonomy of Learning Activities Model (Roberts, Stripling, & Estepp, 2010)

McCubbins, Paulsen, and Anderson (in press) developed a crosswalk of the activities found in the TLA with activities in TBL. Table 2 displays those parallels. TBL activities are embedded in each section of the continuum developed by Roberts et al. (2010).

Table 2
Parallels between the Taxonomy of Learning Activities and Team-Based Learning

TLA (Roberts et al., 2010)	TBL Activity
Teacher-Centered Activities	Preparation
Lecture	Out-of-class reading (or video)
Demonstration	Out-of-class reading (or video)
Social Interaction Activities	Preparation/ Application
Questioning	Individual and team tests
Discussion	Corrective instruction, application activities
Cooperative Learning	Team tests, appeals, application activities
Student-Centered Activities	Application/ Assessment
Inquiry	Individual application exercises, review
Individual Application	Individual application exercises, individual exam/ Project

Note. From "Student Perceptions Concerning their Experience in a Flipped Undergraduate Capstone Course," by OP McCubbins, T. H. Paulsen, and R. G. Anderson, in press, Journal of Agricultural Education. Reprinted with permission.

Purpose and Objectives

Following a recommendation from McCubbins, Paulsen, and Anderson (in press), this study sought to explore the impact of exposure a TBL-formatted capstone farm management course had on students' attitudes and beliefs about learning, motivation to learn, and professional development through critical thinking. This recommendation, as well as TBL's implementation as a newly-adopted instructional approach within the course, provided a supportive foundation for the present study. The development of research-based pedagogies and "enhanced understanding of learning and teaching environments…" (Edgar, Retallick, & Jones, 2016, p. 39) is of utmost importance in meeting agricultural education's goal. This study addresses the American Association for Agricultural Education's National Research Agenda Research Priority Area 4: Meaningful, Engaged Learning in All Environments (Roberts, Harder, & Brashears, 2016). This study is explicitly aligned with the research priority question three which seeks to explore educational programs that "…continually evolve to meet the needs and interests of students" (Edgar et al., p. 39). Specific objectives of this study were to:

1. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development prior to completing the TBL formatted AgEdS 450 course.
2. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
3. Determine if there were changes in student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development after completing the TBL formatted AgEdS 450 course.
4. Determine areas of improvement that would enhance TBL's implementation as perceived by students.

Methods and Procedures

This study was part of a larger research project that sought to examine the effectiveness of the TBL pedagogical practice in an undergraduate capstone course. This study employed a non-experimental, pretest—posttest design in order to measure the impact a TBL formatted course had on student perceptions of their experiences. The researcher identified the target population as all students enrolled in the AgEdS 450 course (N = 121) for the fall 2015 (n = 61) and spring 2016 (n = 60) semesters. The course consisted of a combined lecture period, and two laboratory sections, in which the students met on the farm once per week (Paulsen, 2013).

The Student Learning Experiences (SLE) survey developed by Bickelhaupt and Dorius (2016) was utilized to measure student perceptions of their experience in previous group projects and the TBL format. The instrument consisted of 35 Likert-type questions and two open-ended questions for feedback on the structure of the course. The SLE is comprised of three constructs

(Likert scales), representing three learning domains, and included; 1) beliefs and attitudes about learning, 2) motivation to learn, and 3) professional development through critical thinking. Two of the 35 items were classified as independent measures as they did not situate within the established constructs. The researchers utilized Qualtrics, a web-based survey program, to collect student perceptions within the three learning domains. A pretest–posttest design was utilized to measure change in students' perceptions within three learning domains. The pretest and posttest instruments varied only in how the questions were targeted. The pretest questions focused on previous experience while the posttest focused on the specific experience within the TBL formatted course. For example, a pretest stated "*When a theory, interpretation, or conclusion has been presented in other courses or in previous readings, I try to decide if there is good supporting evidence*," while the posttest was stated as, "*When a theory, interpretation, or conclusion was presented in class or in the readings, I tried to decide if there was good supporting evidence*."

Bickelhaupt and Dorius (2016) established face and content validity by utilizing a panel of experts in survey design and TBL. The instrument was pilot-tested with students (n = 1039) enrolled in TBL formatted courses at Iowa State University to measure reliability (Bickelhaupt & Dorius, 2016). After the pilot study, focus groups were conducted with students to further enhance face validity. Following the suggestions of Urdan (2010), the pilot study conducted by Bickelhaupt and Dorius (2016) resulted in construct reliability coefficients deemed acceptable (α = 0.84 – 0.92). Additionally, McCubbins et al. (in press) utilized the posttest instrument and deemed the resulting reliability coefficients acceptable (α = 0.73 – 0.91). Instruments in the present study were collected from respondents in the fall 2015 (n = 56) and spring of 2016 (n =

54) for a 91.6% response rate (n = 110). Pretest and posttest construct reliability coefficients were deemed acceptable (Table 3).

Table 3
Reliability Coefficients for Student Learning Experience Constructs

Construct	*Post hoc* Cronbach's Alpha Observed		Established Posttest Cronbach's Alpha (McCubbins et al., in press)
	Pretest	Posttest	
Beliefs and Attitudes about Learning	0.97	0.95	0.91
Professional Development through Critical Thinking	0.96	0.93	0.84
Motivation to Learn	0.95	0.75	0.73

After approval from the Institutional Review Board was received, demographic and academic attributes of students were obtained from the Office of the Registrar at Iowa State University. To describe students' academic attributes, university-specific terminology was used, and is described as follows. Semester credit hours were defined as the number of credit hours in which the student was enrolled during the study. Semester grade point average (GPA) was calculated for the semester in which the study occurred. Cumulative credit hours were defined as the total hours received at Iowa State, and cumulative GPA was calculated from Iowa State credits only. Total hours was the sum of all credits including those transferred in from other institutions. Method of entry refers to direct enrollment from high school or transfer from an outside institution. Descriptive statistics were used to describe the student demographic data. To address research objective one and two, measures of central tendency and variability were calculated in SPSS for each construct. For objective three, paired-samples *t*-tests were utilized to determine the significance of differences in student perceptions based upon enrollment in the TBL formatted AgEdS 450 course.

Qualitative data from the two open-ended items were analyzed following Guest, MacQueen, and Namey's (2012) Applied Thematic Analysis (ATA) procedures. ATA is an amalgamation of components from other "…theoretical and methodological camp[s]…" (Guest et al., p.15) that are most useful in an applied context. The applied nature of the study allowed the qualitative data analysis to be conducted through structural coding procedures. Structural coding was "used to identify the structure imposed on a qualitative data set by the research questions and design" (Guest et al., 2012, p. 55).

The present study contained two structural topics (themes) relating to the two open-ended questions; a) suggestions for improvement, and b) general comments. Data bound within these two themes were analyzed through ATA coding procedures, and a codebook was created. The use of intercoder agreement procedures and an external reviewer were employed to strengthen the validity of the qualitative analysis. Intercoder agreement was established through the analysis of segments of the text with the developed codebook by two individuals associated with the research study and one individual not associated with the study (external review). Subjective assessment procedures were employed to resolve "discordant coding" (Guest et al., p. 89) between the researchers and an individual not associated with the study. In the case of a discrepancy, the coders discussed the reasoning, arrived at a solution, and revised the codebook as appropriate. The entire data analysis process was documented in order to establish an audit trail. Verbatim quotes from the participants are utilized throughout as they should be, according to Guest et al., "…pivotal parts of the narrative" (p. 95). Student numbers, in lieu of pseudonyms, were randomly assigned within Qualtrics after the pre- and posttests were matched. The structure imposed on the qualitative data allowed the researchers to focus the narratives to

gather relevant information concerning recommendations for improving the course experience through the participant's voices.

In regards to educational degree pursuit, the results represent a homogenous sample. Care should be exercised when extrapolating results beyond the students enrolled in AgEdS 450. Data gleaned from this study may provide useful insight for instructors of other courses within colleges of agriculture regarding student perceptions towards TBL.

Results

The majority of student respondents were male (n = 85, 77.3%), between 21 and 25 years of age (n = 93, 83.6%), and had direct entry into Iowa State University from high school (n = 60, 54.5%). The average number of credit hours students in which student participants were enrolled was 14.11 (SD = 3.04). The average cumulative GPA was 2.82 (SD = 0.48) and the average composite ACT was 20.84 (SD = 0.32).

Objective One

The first objective sought to determine student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development prior to completing the TBL formatted AgEdS 450 course. Table 4 displays the construct descriptive statistics for the pretest administration of the SLE instrument. The highest rated construct was Professional Development (M = 2.56, SD = 1.09) and the lowest was Motivation to Learn (M = 2.42, SD = 1.04).

Table 4
Pretest Descriptive Statistics for Student Learning Experiences

Construct	*M*	*SD*	*Min*	*Max*
Professional Development	2.56	1.09	1.00	5.00
Beliefs and Attitudes about Learning	2.52	0.99	1.00	4.89
Motivation to Learn	2.42	1.04	1.00	4.67

Note. The SLE Instrument utilized two Likert-type scales. 1 (strongly disagree), 2 (disagree), 3 (Neutral), 4 (agree), and 5 (strongly agree). 1 (not at all true of me), 2 (sometimes), 3 (neutral), 4 (mostly), and 5 (very true of me).

Objective Two

Objective two sought to determine student perceptions after completing the TBL formatted AgEdS 450 course. Table 5 highlights the descriptive statistics stemming from the posttest administration of the SLE instrument. Similar to the pretest administration, the highest rated construct was Professional Development (M = 4.34, SD = 0.61) and the lowest was Motivation to Learn (M = 4.09, SD = 0.62).

Table 5
Posttest Descriptive Statistics for Student Learning Experiences

Construct	*M*	*SD*	*Min*	*Max*
Professional Development	4.34	0.61	1.00	5.00
Beliefs and Attitudes about Learning	4.28	0.62	1.00	5.00
Motivation to Learn	4.09	0.62	1.00	5.00

Note. The SLE Instrument utilized two Likert-type scales. 1 (strongly disagree), 2 (disagree), 3 (Neutral), 4 (agree), and 5 (strongly agree). 1 (not at all true of me), 2 (sometimes), 3 (neutral), 4 (mostly), and 5 (very true of me).

Objective Three

To address the third research objective, multiple paired-samples *t*-tests were conducted in order to compare the means from each of the three constructs from the pretest and posttest administration of the SLE instrument. There was a statistically significant, positive difference in the mean scores for each of the three constructs. The professional development construct had a statistically significant increase from the pretest (M = 2.56, SD = 1.09) to the posttest (M = 4.34,

SD = 0.61), *t* (109) = 14.5, *p* = .000, *d* = 0.71. Student perceptions regarding beliefs and attitudes about learning was found to have a statistically significant increase from the pretest (*M* = 2.52, *SD* = 0.99) to the posttest (*M* = 4.28, *SD* = 0.62), *t* (109) = 14.9, *p* = .000, *d* = 0.73 as well.

Table 6
Paired Samples t-test Results of Student Learning Experience Pretest and Posttest (n = 110)

	Pretest		Posttest			95% CI					Effect
	M	SD	*M*	*SD*	Diff.[a]	*LL*	*UL*	*t*	*p*[b]	*df*	Size[c]
Professional Development	2.56	1.09	4.34	0.61	1.78	1.53	2.02	14.5	.000*	109	0.71
Beliefs and Attitudes about Learning	2.52	0.99	4.28	0.62	1.76	1.53	1.99	14.9	.000*	109	0.73
Motivation to Learn	2.43	1.04	4.09	0.62	1.66	1.43	1.89	14.2	.000*	109	0.70

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.
[a]Posttest minus pretest; [b]Probability of difference; [c]Mean difference divided by group *SD* (0.02 = small; 0.5 = medium; 0.8 = large).

To determine if there was a statistically significant association between the mean differences and select demographic variables (GPA and credit hours), a correlation was calculated. Since the assumption of normality was not violated, Pearson correlations were computed. There was a slight negative correlation between GPA and the motivation to learn mean difference, *r* (108) = -.26, *p* = .006; attitudes and beliefs about learning mean difference, *r* (108) = -.29, *p* = .002; and professional development mean difference, *r* (108) = -.26, *p* = .027. There were no statistically significant associations between GPA, the number of credit hours taken, and mean difference for each construct.

Independent samples *t*-tests were computed to determine differences between mean differences for each construct and select demographic variables (gender and method of entry). No statistical differences were found in those computations.

Objective Four

Research objective four sought to identify general student perceptions and specific areas for improvement within the AgEdS 450 course. Open-ended questions were utilized to gather general student input (i.e., Please provide any additional information you would like to share regarding your experience as an individual learner or working with your team in this course) and specific areas for improvement in the TBL formatted capstone course (i.e., What, if anything, would have enhanced your Team-Based Learning experience during this course). Structural topics (themes) were suggestions for improvement and general comments.

Suggestions for Improvement

The suggestions for improvement theme was segmented by three defining codes including; a) team activities, b) communication, and c) course organization. Several students responded with nothing, not applicable, or no. Lacking context, these responses were simply flagged as 'Other' in the analysis. This prevented those specific responses from being interpreted as complete satisfaction or dissatisfaction.

Team activities

The team activities code was applied to responses that revolved around specific team activities within the course. Based on the responses, students desired more team activities be incorporated throughout the semester. One student desired more homework for various course topics that teams would complete outside of class time. Another student discussed wanting more projects to be completed in their teams. Specifically, the student said, "I think that working on more things within the class would have helped. All we did in teams was the IRAT, TRATs, and application exercises whereas we worked with our committees on multiple projects" [*Student 04*]. Another student felt that the teams should be utilized in completing "…more tasks and

projects rather than just the t-rats" [*Student 12*]. This sentiment was echoed by several other students throughout the text as well. Another student exclaimed, "More opportunities to work with my team" [*Student 94*]. One student discussed the benefit of working in teams and used that as justification for the incorporation of more team activities. Specifically, the student stated, "Possibly add more application exercises. They were challenging and encouraged us to work together and I enjoyed that" [*Student 22*]. A few responses indicated the need to develop a team activity that aids in the establishment of group norms amongst the teams. "If all of the members in my group actually cared as much as I did" [*Student 63*], was mentioned by one student while another stated, "the large group numbers made it difficult to keep everyone always on task" [*Student 14*]. Other students noted the importance of equal contributions within the teams, feeling connected to their teammates, and establishing their own standards to engage in formative peer evaluations outside of those conducted as part of the course. A few students mentioned specific types of additional team activities or application exercises that revolved around commodity marketing. One student stated:

> My suggestion for this class would be to have a team based marketing assignment that you have to do in your groups, 'using the 450 farm as an example' and I think that will help people get more involved with the marketing of the grain at the 450 farm [*Student 05*].

A similar response was provided from another student who stated:

> The [marketing] simulator was really neat. It helped ease my anxiety in marketing grain. It allowed us to try different versions of a marketing strategy to maximize profits. Instead of it being an individual assignment, I think it should be completed in teams. Have each

team develop a marketing plan based on the farms actual numbers and provide the matrix and justification of the strategies chosen [*Student 101*].

Communication

The second code label revolved around communication issues. The communication code was applied to responses that discussed issues or suggestions on improving student-to-student communication. The issues frequently reported/suggested were in regards to student–student communication across the lab sections. Specifically, one student stated, "Have our labs meet the same day, instead of a two day time period" [*Student 27*], while another student said, "it was hard to coordinate between people in both sections" [*Student 35*]. Additionally, a student noted the difficulty in keeping up with what the other section was working on throughout the week and the resulting frustration. The student stated, "Better communication across sections. Felt like I didn't know what Wednesday's lab did and that got frustrating" [*Student 11*]. One student suggested incorporating the utilization of a group messaging smartphone application as part of the course grade. Another suggestion to overcome student–student communication issues offered by several students was combining the lab sections, or meeting for labs on the same day of the week at staggered times. For example, "Build a bigger classroom at the farm so we can all meet out there. Meeting on campus sucks because we don't have access to everything that could aid us in making decisions" [*Student 97*]. Another student suggested that the course "have labs during the same day but at different times. Have the first lab meet from 9 to 1 and the second lab meet from 12 to 4. This hour overlap would allow for greater collaboration amongst teams and committees" [*Student 92*]. Another student recognized the limitations of the classroom facilities at the farm but still suggested the labs meet at the farm together. Specifically, "I know it isn't

feasible, but having a big enough classroom so that we could all do lab at the same time would help" [*Student 87*].

Course Organization

Course organization codes were applied to responses related to how teams should be formed, organization of the online content for the pre-class material, and the credit hours offered. In regards to team formation, several students expressed a desire to self-select teams or having the committees and teams be comprised of the same individuals. One student said, "I would like to be able to choose our teams instead of random selection" [*Student 15*], while another stated, "having both the committees and teams be the same people" [*Student 41*]. Another student suggested that by utilizing the teams as committees, the students would get to know each other better. Another student was adamant about that same idea and stated, "Committees are better than teams. You can't form a team with the little amount of time spent together. While teams encourage greater communication they don't do anything for the learning environment. Committees are more beneficial than teams" [*Student 07*]. Other students suggested incorporating more individual homework to strengthen the content covered in specific modules. Specifically, a student suggested "more individual homework to help more students understand some of the important aspects of farm management. This would be particularly helpful in the finance module" [*Student 81*]. Another student expressed a desire to gain more knowledge outside of class time to limit what their teammates had to help teach. Specifically, that student stated:

> More personal knowledge that I could gain outside of the course on my own. I had to learn things a lot of people already knew so it was difficult for me. Not a class issue more

of my issue. I thought the class was great. Team helped me learn things better and more of a hands on way [*Student 88*].

A few students also suggested visiting how the online content is viewed but offered no concrete suggestions for improvement. One other student suggested the course be worth more than three credits.

General Comments

The general comments theme was also segmented by three codes that included; a) autonomy/supportive autonomy, b) cohesive teams, and c) student transformation. The analysis of the data from the general comments structural topic lead to three code descriptions. The student responses from this question were all positive comments in regards to the student's experiences in AgEdS 450.

Autonomy/supportive autonomy

The autonomy/supportive autonomy code was bounded by responses expressing assuming responsibility for one's own learning as well as responses that discussed conditions that support autonomy. Students were very positive in regards to the shift in authority within the classroom environment. One student noted hesitation to the TBL format, but that it did lead to increased engagement in the course. Specifically, the student said, "TBL allows us to take responsibility for our own learning. I was hesitant at first, but it really became fun to come to class and engage in thoughtful conversations and discussions about farm management" [*Student 25*]. Another student stated, "It was intriguing that we got to decide our grade weights [individual performance, team performance, and peer evaluation] for the class. I think it helps with keeping students accountable, because I know it did for me" [*Student 109*]. Similarly, a student thought "it was cool that we set our grades based on those three categories. I thoroughly

enjoyed the interactions with my team members and the instructors" [*Student 06*]. Another student exclaimed, "Thanks go to the teaching team for treating us like adults and really pushing us to make decisions. From setting our grade weights to letting us make huge financial decisions, no other class is like this" [*Student 08*]. Another student discussed the importance of peer accountability through the peer evaluations. The peer evaluations, developed from student input, allowed everyone to be held accountable. A student said, "The peer evaluation holds this entire thing together. Good [sic] on the instructors for making sure it was incorporated throughout the semester" [*Student 35*]. Another student echoed the previous statement with, "By being part of a team, we are able to hold each other accountable, making sure we are getting the work done that needs to be done" [*Student 42*].

Cohesive teams

The transferable skills code encompassed responses that shared an increase in specific skills such as teamwork, problem solving, making decisions, analyzing differing views, or overcoming various issues within the course. Specific discussion of activities that students felt contributed to the development of their team or skills was situated within this theme. Responses included an appreciation for diverse background experiences and ideas, negotiations, discussion, and peer teaching/learning. One student mentioned the realization that the committees also formed a *team* within the capstone course and that their involvement in two teams (team and committee) was very beneficial. "The team based learning format gives us the opportunity to learn from our peers and bounce ideas off of one another" [*Student 44*] was one student's response. Another noted the initial disdain for their team stemming from preconceived notions of social loafing. The student continued explaining how they eventually appreciated the team and that they were great to work with. Specifically, "I'm glad we didn't pick our groups, though I

wasn't happy with my group at first because I thought they wouldn't do much, they ended up being really great and that did teach me something" [*Student 71*]. Another student discussed the benefit of overcoming student–student communication issues and by doing so is beneficial to life after academia. The communication issues force students to "…find new ways to communicate with team members, which in the end will help prepare them for life after college" [*Student 35*]. Several students mentioned an appreciation for the diverse teams and how working with their teams contributed to the course experience and further extended the idea of preparation for life after college. One student stated, "The biggest benefit of having a team is having a group of individuals from different specialized areas of the farm who can bring their ideas and knowledge together to accomplish common goal," [*Student 81*] while another stated, "I usually like working by myself, but with teams it helped you to see other point of views, or how other students approached a problem" [*Student 77*]. Other students with similar opinions stated:

> Team based learning helps promote communication between groups and group members. Throughout college most classes are not team based; I believe that through team based learning assignments students will be more prepared for life after college [*Student 05*].

> My team was absolutely amazing. They all had great knowledge to bring to the table and I am very glad I got the opportunity to work with them. We got to solve practical problems in hypothetical situations and then apply that in a live scenario [*Student 68*].

> After graduation I expect many graduates to find themselves working on projects with coworkers in different jobs all around the world, team based learning is a great way for students to prepare themselves for the real world workplace environment. TBL takes

> some getting used to but I think it worked great. It really makes you think about others perspectives and challenges your own way of thinking [*Student 92*].

Student transformation

The final code, Student Transformation, was applied to thoughtful reflections on the overall course experience. Although only four responses were labeled student transformation, it provides a holistic caption of the respondent's opinions concerning their experience. The responses sagaciously discussed a widened frame of reference as a result of their experience in the course or associated with specific course activities. In relation to the entire course experience, one student bluntly stated:

> I had a previous class that was taught with TBL and it was a cluster [expletive]. Kudos to [instructor] for making me realize it isn't as [expletive] as I thought it was originally and for allowing us to be involved in the decision making. I was worried when I read the introductory module stuff on TBL that this class would be awful [*Student 10*].

Another student discussed the importance of negotiating and thinking about various ideas from multiple perspectives. Specifically, the student said:

> I learned the importance of negotiation and how to successfully negotiate without arguing. I would try to understand that there are two sides to every story and get a better feeling for the other person's thoughts and feelings without crossing boundaries. Throughout the semester, I did not always agree with other's thoughts and ideas, but I would try to set my personal bias aside and focus on the situation at hand. Working with others in very important in today's market place and what "clicked" in this situation is that fact that I will be working with others my entire life [*Student 55*].

Expressing an appreciation for diverse background experiences, and providing a specific example, one student stated:

> I truly believe the team based learning helped me a lot. I distinctly remember the seed selection application exercise. It was interesting to hear my team member's thoughts and ideas about selecting varieties since the company name was a major influence. Being able to understand the terminology and the difference between varieties is vital in choosing the best varieties for a particular farm and something that I am required to do to ensure continued success on our family farm. As my father selects seed in the fall for the following year, this experience will allow me to help him make the best decision for our farm. Not only providing insight with the terminology, but also ensuring that he is comparing the same traits for different varieties or companies can ensure the process is effective and efficient [*Student 56*].

Another student noted the development of team identity does not occur immediately. It takes a few weeks for students to become open to the idea of engaging in conversation. Specifically, the student stated:

> TBL pushes students out of their comfort zone to engage in collaboration. When we first started the semester, a few of my teammates would not engage in conversation, nor offer insight on our T-RATs as they were rather quite. After the second or third week, these students started to engage in activities and since then have added a positive asset to our team. I think if your teams were any bigger, these students would not have engaged in collaboration [*Student 16*].

Conclusions and Discussion

TBL is a significant shift in traditional content delivery techniques. Students receive the content prior to attending a class session which opens the majority of class time for the application of content knowledge in a team setting. This transition in the learning environment likely served as a disorienting dilemma (Mezirow, 2000) for students. Alongside quantitative measures, student voices were heard through two structured questions in order to examine the benefit of this atypical teaching approach. The evaluation of meaningful learning environments is a convoluted task but is essential to guide learning and engagement (Edgar et al., 2016). Contemplative of that sentiment, it is concluded that the implementation of TBL within the capstone course framework develops an engaging learning environment in which students assume responsibility for their own learning while working collaboratively to solve real-world problems. This particular application of TBL contributes to the professional development of students and strengthens their perceived ability to apply course concepts to situations after graduation.

Across all three constructs, statistically significant increases in student perceptions were observed. These results are encouraging as the need for research-based pedagogical practices are important for instructors of agriculture (Edgar et al., 2016). Furthermore, the pretest and posttest results offer valuable insights on overcoming preconceived notions stemming from past negative experiences in working with other students, similar to Espey's (2010) findings. These findings support the continuation of the TBL instructional approach within AgEdS 450 as well. Similar to previous research on flipped classrooms in agricultural contexts (Barkley, 2015; Conner et al., 2014a; Conner et al., 2014b; Gardner, 2012; McCubbins et al., in press), students viewed this TBL formatted course favorably. TBL, in this context, reinforced specific critical thinking

abilities, fostered student's motivation to learn the content, aided in the self-perceived ability to connect theory to practice, and widened students' frames of reference. Students felt that the time spent working with groups was beneficial in holding them accountable to various assignments and farm-related tasks.

In conclustion, TBL is a useful approach in transformative learning. Mezirow (2000) discussed the importance of analyzing individual experiences in the process of assessing reasoning and making meaning. As is obvious in the qualitative responses, this iteration of TBL allowed students to engage with other individuals and negotiate throughout the semester. In reference to the model for integrating TBL into a capstone course (Figure 2), it is apparent that the fragmented disciplinary knowledge (Crunkilton et al., 1997) is present. Through the structure of this course, students were able to question their previous assumptions–as they related to the course content and the value they placed on working with others–and engage in rational discourse to widen their frames of reference (Mezirow, 2000).

Recommendations and Implications

Mezirow (2000) noted the importance of a trusting, social context to nurture transformative learning, which is supported by the current findings as well as previous research (McCubbins, Paulsen, & Anderson, in press). Continual evaluation of student perceptions in this particular course is recommended. It is further recommended that student outcomes be evaluated alongside similar data. Evaluating student performance on exams compared to their perceptions of TBL would be of particular interest, and could hold significant implications for the instructional approaches employed by faculty members within agricultural education, broadly defined.

As recommended in McCubbins, Paulsen, and Anderson (in press), critical thinking abilities should be measured before and after exposure to TBL. This data could be compared to national norms, similar to what was conducted in Perry et al.'s (2015) work, who recommended the examination of critical thinking in line with active learning strategies. Additionally, comparison of student performance in TBL formatted courses versus traditionally taught (i.e., lecture based) courses within Colleges of Agriculture is warranted. This could potentially expand the significance and utility of the findings from the present study.

We also recommend considerable attention be given to faculty professional development workshops on designing, implementing, and sustaining student-centered frameworks (Balschweid et al., 2014; McCubbins et al., in press). With consideration of the potential barriers in the adoption of student-centered course design (Hains & Smith, 2012), it is likely time for faculty members within agricultural education to advocate for more emphasis on teaching and learning in the alignment of institutional responsibilities. Traditionally, "effective teaching has continually been hampered by pedagogical constraints, such as time, materials, and ever changing technological advances" (Edgar et al., p. 38). TBL, while not a panacea, provides a solution to the hampering of effective teaching practices. It is long past time that those charged with teaching students for a changing world quit handicapping those students by the perpetuation of teaching methods known to be less effective.

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CHAPTER V. STUDENT ENGAGEMENT IN A TEAM-BASED CAPSTONE COURSE: A COMPARISON OF WHAT STUDENTS DO AND WHAT INSTRUCTORS VALUE

A paper prepared for submission to the *Journal of Agricultural Education.*

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Abstract

Student engagement is an important consideration across all levels of education. The adoption of student-centered teaching methods is touted as an effective way to increase student engagement. Student engagement is at risk when instructor expectations and student participation in purposeful engagement activities are not aligned. Traditionally, student engagement is measured at the institutional level which proves less than useful to instructors who wish to gauge engagement in specific courses. A capstone farm management course at Iowa State University was recently converted to the Team-Based Learning format to foster student engagement. The purpose of this study was to determine classroom level engagement by comparing student perceptions regarding participation in engagement-specific activities with the instructors' perceived importance of those same activities. The Classroom Survey of Student Engagement was utilized to collect the student participation and instructor importance data. Data were examined utilizing a 2x2 quadrant analysis. Congruence between student participation frequency and instructor importance was found between 73.7% of the educational activities, while discrepancies were found on 26.3% of educational activities. Overall, students who completed the TBL-structured capstone farm management course were physically and psychologically engaged in the learning environment. It is recommended that TBL be

implemented in other courses within Agricultural Education to examine its utility in other contexts.

Keywords: student engagement, active learning, team-based learning, capstone course

Introduction and Literature Review

Student engagement is an important factor to consider within the landscape of higher education, and as a topic of interest for educational researchers, it has experienced considerable growth in recent years (Barkley, 2010; Bowen, 2005; Korobova & Starobin, 2015; Mandernach, 2015). The basis for this increased interest is ultimately driven by a mission of higher education to improve student learning (Reschly & Christenson, 2012). Additionally, it has been argued that student engagement is the most important factor impacting student learning and development (Hu & Kuh, 2002), and has been identified as an effective indicator of student outcomes (Kuh, Pace, & Vesper, 1997). Student engagement can be a useful tool to understand or improve various student outcomes as well (Finn & Zimmer, 2012). It would stand to reason that with its considerable importance, engagement has been well defined in the extant literature but "…definitional clarity has been elusive" (Appleton, Christenson, & Furlong, 2008, p. 370), possibly due to a shifted focus several times in the last few decades (Kuh, 2009; McCormick, Kinzie, & Gonyea, 2013). As a result, a variety of definitions and conceptualizations of what is meant within the engagement literature have been extended. Several researchers have promulgated this issue in recent years (Appleton, Christenson, & Furlong, 2008; Axelson & Flick, 2011; Bowen, 2005; Shulman, 2002). Specifically, Bowen (2005) declared that a consensus on what is meant by engagement or why it is important is nonexistent, while Shulman (2002) posited that learning begins with engagement, therefore making it one of the most important aspects in the learning process.

Some researchers purport engagement should be viewed as a three-part typology that includes behavioral, emotional, and cognitive aspects (Fredericks, Blumenfield, & Paris, 2004; Jimerson, Campos, & Grief, 2003; Lam et al., 2012; Marx, Simonsen, & Kitchel, 2016; Sinclair, Christenson, Lehr, & Anderson, 2003). A multidimensional view of the engagement construct (Appleton, Christenson, & Furlong, 2008; Appleton, Christenson, Kim, & Reschly, 2006) highlights its complexity as it is often regarded as a metaconstruct (Axelson & Flick, 2011; Jimerson, Campos, & Grief, 2003; Lam et al., 2012; Sinclair, Christenson, Lehr, & Anderson, 2003). Specifically, Fredericks, Blumenfield, and Paris (2004) identified three dimensions of student engagement that included behavioral, emotional, and cognitive factors; a conceptualization echoed by Marx, Simonsen, and Kitchel (2016) in their examination of student course engagement. The wide-ranging definition of engagement, while contributing to the "conceptual haziness" of the construct (Reschly & Christenson, 2012), is well suited for purposes of institutional accountability. This sentiment seemingly aligns with Marx et al.'s assertion that "engagement is most extensively analyzed globally within the total college experience through the works and related works of George Kuh" (p. 213).

Kuh (2003) explained, "The engagement premise is deceptively simple, even self-evident. The more students study a subject the more they learn about it" (p. 25). This was not a dismissal of the intricacies relating to student engagement, but a means to measure how institutional practices impact the students they serve. Axelson and Flick (2011) contended the adoption of a narrow definition of student engagement–one that focused on student involvement in the learning process–would result in the utilization of student involvement data for immediate program improvement decisions. Specifically, Axelson and Flick (2011) declared, "To support the research and program improvement uses of student engagement, we believe that a narrower

definition of the term is needed, one that is restricted to students' level of involvement in a learning process" (p. 41). More meaningful programmatic improvements regarding student engagement within higher education would have an immediate impact on the undergraduate educational experience (Ewell & Jones, 1996). These sentiments are shared by several researchers throughout the educational literature (Banta, Pike, & Hansen, 2009; Hemsley-Brown & Sharp, 2003; McCormick, Kinzie, & Gonyea, 2013).

Ewell and Jones (1996) discussed the general public's pressure on institutional accountability that led to an increase in the assessment of student outcomes during the 1980s. A serious disconnect existed between the faculty responsible for teaching students and the technical assessment specialist conducting the outcomes assessments. This led to faculty resistance based on the limited utility of information relative to improving the teaching and learning process (Ewell & Jones, 1996). The noted disconnect led to recommendations by several researchers to develop measurement procedures to collect information on specific instructional approaches and student experiences to be included in institutional accountability measures (Astin, 1991; Ewell & Jones, 1996; Ewell, 1996; Pace, 1984). In an effort to determine practices with positive impacts on students at the postsecondary level, Chickering and Gamson (1987) synthesized decades of research to develop "…seven broad principles for good practice in undergraduate education" (Cruce, Wolniak, Seifert, & Pascarella, 2006, p. 365). Chickering and Gamson (1999) sought to set forth accessible, synthesized evidence for faculty, administrators, higher education agencies, and policymakers. The principles were developed with practicality and understandability in mind. Chickering and Gamson's (1987) good practices in undergraduate education included: 1) encourages contacts between students and faculty, 2) develops reciprocity and cooperation among students, 3) uses active learning techniques, 4) gives prompt feedback, 5) emphasizes

time on task, 6) communicates high expectations, and 7) respects diverse talents and ways of learning (p. 2). Ewell and Jones (1996) noted the overwhelming support and value placed upon the principles as process indicators of student success because they were "…agreed upon by the wider academic community, and are known to work" (p. 7). The value was strengthened because they could be utilized in determining how committed institutions were in improving the undergraduate educational experience. Kuh, Pace, and Vesper (1997) echoed the importance of utilizing these types of process indicators for examining student outcomes. The publication and support of these principles has spawned a surfeit of educational research interested in examining the interaction of the seven principles on student outcomes (Bangert, 2004; Chickering & Gamson, 1999).

Viewed as a result or as a process indicator, the panoply of literature regarding student engagement provides "one unequivocal conclusion… the impact of college on learning and development is largely determined by an individual's quality of effort and level of involvement in both the curricular and cocurricular offerings on campus" (McCormick, Kinzie, & Gonyea, 2013, pp. 53-54). This particular conceptualization of student engagement highlights the importance of the institutional practices of higher education. In regards to institutional conditions, the teaching and learning approaches utilized are of considerable importance to student success. Unsettlingly, those who teach within institutions of higher education are generally not trained in any formal means of pedagogy, curriculum design, or assessment strategies (Balschweid, Knobloch, & Hains, 2014; Maxwell, Vincent, & Ball, 2011; Tinto, 2012).

Based upon the extant literature in agricultural education contexts, it would seem that these indicators of good practice resonate at a much lower frequency than desired. Many studies

assert that faculty members within Colleges of Agriculture are most competent or efficacious in lecturing (Blickenstaff, Wolf, Falk, & Foltz, 2015; Harder, Roberts, Stedman, Thoron, & Myers, 2009; Stedman, Roberts, Harder, Myers, & Thoron, 2011; Wardlow & Johnson, 1999). Blickenstaff, Wolf, Falk, and Foltz (2015) reported a critical need for faculty professional development training in the areas of engaging students in the learning process, improving student reading/writing, and promoting the development of critical thinking ability of students. College of Agricultural and Life Sciences faculty must engage students in the learning process in order to contribute to long-term outcomes (e.g., employability based on transferable skills such as communication, critical thinking, and problem solving) (Blickenstaff et al., 2015). These long-term outcomes can be addressed through instructional approaches that intentionally incorporate active learning strategies. Previous studies have found low levels of student engagement in lecture-based courses (Chickering & Gamson, 1987; Ewing & Whittington, 2009; McCarthy & Anderson, 2000; Mennenga, 2012; Whittington & Newcomb, 1993; Whittington, 1995), while active learning strategies have shown an increase in student engagement (Lightner, Bober, & Willi, 2007; Tucker, 2012). Estepp and Roberts (2013) recommended instructors employ a variety of active learning strategies including discussion, team-based activities, projects, and presentations to promote student engagement.

Active learning strategies, an indicator of good practice (Chickering & Gamson, 1987), have been shown to improve student performance on critical thinking measures (Gokhale, 1995), as well as leading to an increased ability to transfer skills to other contexts (e.g., transfer of critical thinking to teaching younger students) (Yang, 2012). The promotion of higher order thinking skills by incorporating previous experiences to course material (Richmond & Hagan, 2011), and a positively perceived learning environment from the students' (McCubbins, Paulsen,

& Anderson, in press) and teachers' (Duron, Limbach, & Waugh, 2006) perspective have also been linked to active learning strategies. Active learning environments contribute to the development of specific abilities related to critical thinking (i.e., evaluating information, synthesizing and evaluating ideas, and solving problems) (Gokhale, 1995; McCubbins, Paulsen, & Anderson, in press; Perry, Paulsen, & Retallick, 2015). Ensuring these long-term outcomes are realized can be accomplished through a number of course structures, including capstone courses (Crunkilton, Cepica, & Fluker, 1997; Perry, Paulsen, & Retallick, 2015).

Capstone Courses

Capstone courses are meant to serve as an experience with the intent of easing student's entry into the workforce or further academic study (Crunkilton, Cepica, & Fluker, 1997). Specifically defined, capstone courses are "a planned learning experience that requires students to synthesize previously learned subject matter content and to integrate new information into their knowledge base for solving simulated or real world problems" (Crunkilton et al., p. 3). Outcomes of considerable importance to capstone courses are teamwork, problem-solving, critical thinking, communication, and decision making (Crunkilton et al.). In order to achieve those outcomes, projects, case studies, or issue analysis, small group work, oral communication activities, intensive writing, and industry involvement should be integral components of the capstone course curriculum (Crunkilton et al.). The benefits of these activities and their benefits in regards to capstone courses have been addressed throughout the literature (Andreasen & Trede, 2000; Downey, 2012; Henneberry, 1990; Kerka, 2001; McCarthy, 1985; Paulsen, 2010; Wagenaar, 1993; Zimmerman, 1991; Zimmerman, 1997).

Andreasen and Trede (2000) recommended a concerted effort in improving course activities to ensure capstone course outcomes are realized (e.g., collaboration and

communication). Furthermore, Perry, Paulsen, and Retallick (2014) called for instructors of capstone farm management courses to utilize instructional approaches that emphasize student-centered discussions, oral and written communications, as well as issue analyses.

Team-Based Learning

Team-Based Learning (TBL) is an instructional approach that falls under the active learning umbrella (McCubbins, Paulsen & Anderson, in press; Nieder, Parmalee, Stolfi, & Hudes, 2005) and emphasizes the use of small groups (Michaelsen, Knight, & Fink, 2004). Teaching approaches that utilize small groups have much empirical support throughout the literature. Specifically, the use of small groups promotes cognitive elaboration, enhances critical thinking, promotes social development, and creates conditions conducive for frequent feedback (Cooper & Robinson, 2000; Michaelsen et al., 2004, Michaelsen, Sweet, & Parmalee, 2008). Appropriate utilization of small groups can have a positive effect on previous negative experiences of group work reported by students (Espey, 2010).

In TBL, a course is broken down into modules that are typically two weeks or longer, and build from simple to complex (Michaelsen, Knight, & Fink, 2004). At the beginning of a TBL-structured learning module, students engage in the introductory material prior to attending class. Once in class, students are assessed individually and again as a team over the introductory material. The remaining time in class is dedicated to completing application exercises in teams, which allows students to apply course content to real-world problems (Michaelsen, et al., 2004). These application exercises are designed under a framework known as the 4S's and include: 1) significant problem, 2) same problem, 3) specific choice, and 4) simultaneous reporting (Michaelsen et al., 2004; Sibley & Ostafichuk, 2014). All student teams complete the same application exercises that presents a significant problem, resulting in a specific decision, and that

decision is reported within a class session simultaneously. Students discuss and work through these problems with other students in their teams before making a decision. Once the decision from each team has been reported, the instructor facilitates discussion between teams (Michaelsen et al., 2004, Sibley & Ostafichuk, 2014).

Theoretical/Conceptual Framework

The framework for this study is grounded in Astin's (1999) Student Involvement Theory (SIT) and the engagement literature. SIT is grounded in decades of research elucidating that involvement references the "…quantity and quality of the physical and psychological energy students invest in the college experience" (Astin, 1999, p. 528). Specifically, SIT is rooted in Astin's (1975) longitudinal work on student persistence as it related to involvement. Student lack of involvement is often signaled by passivity. Astin (1999) explained that the behavioral aspect of student's involvement is critical. In other words, what the student does in the learning environment signifies involvement. Five postulates were developed in regards to SIT and include: 1) involvement is the investment of physical and psychological energy in objects (generalized or specific), 2) involvement occurs along a continuum for all students, 3) involvement can be measured both quantitatively and qualitatively, 4) the quality and quantity of involvement is a predictor of student learning and development, and 5) educational policy or practice can only be deemed effective based on the capacity to increase student involvement (Astin, 1999). When concentrating efforts on instructional approaches–those that nurture student involvement–higher education institutions can expect significant benefits (Smith, Sheppard, Johnson, & Johnson, 2005).

The evolution of the engagement construct led to considerable dissension on the operational definition of student engagement (Appleton, Christenson, & Furlong, 2008; Bowen,

2005). Kuh (2009) espoused that the modern conceptualization of engagement emanated from previous research involving time on task, quality of effort, student involvement, social and academic integration, good practice for undergraduate education, as well as student outcomes research.

Kuh (2001) synthesized existing research on the impact that process indicators (e.g., specific educational activities) had in relation to student success in an effort to reform institutional practices. His ultimate goal was to provide data that could be utilized by higher education institutions in making informed decisions to provide quality educational practices to the students they serve. This resulted in the development of the National Survey of Student Engagement (NSSE) and was grounded in research tied to practices that had high correlations with desired student development outcomes (Kuh, 2009). NSSE's core purposes included improving the undergraduate experience, documenting good practice, and public advocacy (Kuh, 2009). These process indicators have been empirically linked to student success. Cruce, Wolniak, Seifert, and Pascarella (2006) described the research supporting the predictive validity of each of Chickering and Gamson's (1987) principles. The weight of evidence synthesized by Cruce et al. related to each principle is substantial.

Conceptually, this study is situated within Kuh, Kinzie, Buckley, Bridges, and Hayek's (2007) model on factors that affect student success (Figure 1). Kuh et al. (2007) purported student engagement lies at the intersection of institutional conditions and student behaviors. This study focused on the central area of Figure 1, paying particular attention to teaching and learning approaches (institutional conditions) and various student behaviors.

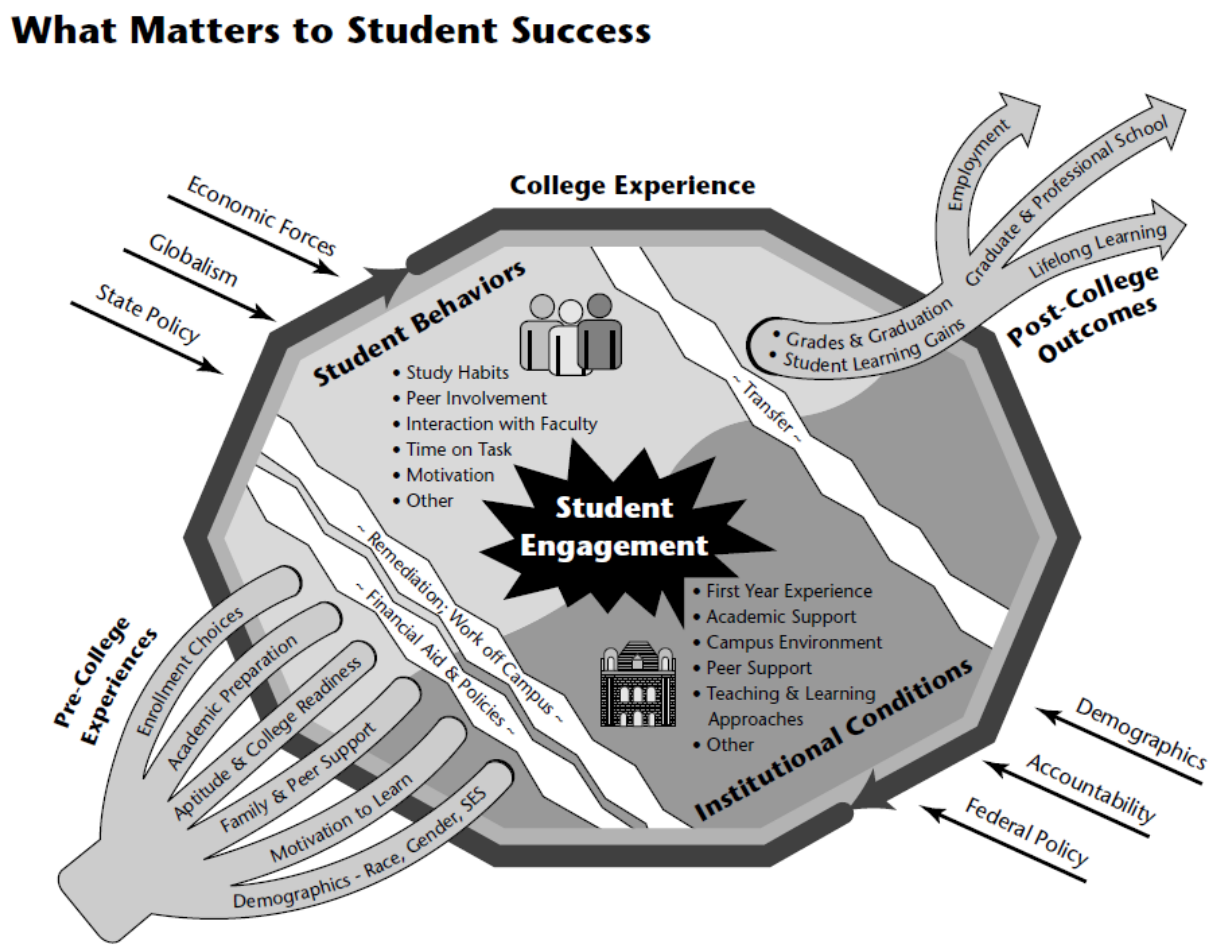

Figure 1. What matters to student success. From "Piecing Together the Student Success Puzzle: Research, Propositions, and Recommendations," by G. D. Kuh, J. Kinzie, J. A. Buckley, and J. C. Hayek, 2007, *ASHE Higher Education Report, 32*(5), p. 11. Reprinted with permission.

Student behaviors include study habits, involvement with other peers, interaction with faculty members, and their motivation to participate in other educational activities. Institutional practices involve academic support, the general campus environment, and teaching and learning approaches provided by the institution. The coalescence of institutional conditions and student behaviors have the potential to contribute to student engagement, which is empirically linked to student satisfaction, learning gains, and other long term outcomes (i.e., graduation, employment, and lifelong learning) (Kuh et al., 2007).

Purpose and Objectives

Learning environments may be less effective when a mismatch exists between the teachers' and the students' expectations and conceptions of the teaching and learning process (Chalmers & Fuller, 1996). Smallwood (2008) praised the utility of student engagement data when collected at the classroom level and noted the increased likelihood for curriculum improvement when collected at the local level. The value of educational activities varies across and within faculty, making any resulting data from institution-wide examinations of student engagement difficult to interpret; while classroom-level examinations of student engagement allow for localization of variation in student engagement (Smallwood, 2008). Laird, Smallwood, Niskodé-Dossett, and Garver (2009) noted the assessment of student engagement is often conducted by informal means (i.e., taking attendance or observing student behaviors), and further discussed the utility of a class-specific measure of student engagement instrument for improving course design. Marx et al. (2016) identified a gap in localized engagement data and the importance of describing "…the perceived engagement of undergraduate students…" (p. 213). For AgEdS 450, student evaluations of the course are fundamental components to improving the structure and curriculum. Students that have completed a specific course become important information sources for determining the effectiveness of the course and its activities (Soomro, 1991). The purpose of this study was to determine classroom level engagement by comparing student perceptions regarding participation in engagement-specific activities with the instructors' perceived importance of those same activities. This study was substantiated by Priority Area Four of the National Research Agenda (Edgar, Retallick, & Jones, 2016; Roberts, Harder, & Brashears, 2016). The investigation of various teaching approaches may help identify methods

that appropriately promote "…engagement and learning" (Edgar et al., p. 39) within the classroom. Specific objectives that guided this study included:

1. Determine the importance of engagement-specific activities within the AgEdS 450 course as reported by the instructional team–instructor, teaching assistant, and farm operator.
2. Determine the frequency of student participation in engagement-specific activities within the AgEdS 450 course.
3. Determine correlations between importance and frequency of engagement-specific activities within the AgEdS 450 course.

Methods and Procedures

This study is part of a larger, more comprehensive study designed to examine the effectiveness of the implementation of TBL in a capstone course in a robust manner. The present study employed a non-experimental, descriptive research design, to measure student engagement in a TBL formatted capstone course. All students enrolled in the AgEdS 450 (N = 121) course for the fall 2015 (n = 61) and spring 2016 (n = 60) semester were identified as the target population. AgEdS 450 is a capstone course for Agricultural Studies majors at Iowa State University and, as its primary outcome, is to provide students with real-world experiences grounded in the tenets of Crunkilton et al.'s (1997) capstone course components. The course was recently revised to a TBL structure. TBL is a student-centered teaching method that emphasizes small group work and the application of content (Michaelsen et al., 2004). Students enrolled in the course met for a combined lecture period on campus, and were split into two laboratory sections that met on the farm once per week (Paulsen, 2010). The Classroom Level Survey of Student Engagement (CLASSE), derived from the National Survey of Student Engagement (NSSE) (Kuh, 2004), is a two-part instrument "that compares faculty expectations with what

students report experiencing in a class" (Ouimet & Smallwood, 2005, p. 13). The NSSE instrument, based on a research foundation concerning student engagement (Coates, 2009; Kuh, 2004), provides a holistic view of an institutions level of student engagement.

While the NSSE focuses on institutional level engagement, the CLASSE focuses on classroom-level engagement. CLASSE is also not grade specific, whereas the NSSE is typically targeted to first-year and senior students (Ouimet, 2011). The engagement indicators remain constant within both the NSSE and CLASSE; the major alteration is the wording to be class specific versus institution-wide (Ouimet & Smallwood, 2005). An example from NSSE is: *During the current school year, about how often have you done the following? Asked questions or contributed to course discussions in other ways.* The response options include *Very Often, Often, Sometimes,* and *Never*. The CLASSE focuses on classroom specific behaviors. An example from CLASSE is: *So far this semester, how often have you done each of the following in your [COURSE NAME] class? Asked questions during your [COURSE NAME] class. Contributed to a class discussion that occurred in [COURSE NAME] class*. Response options for these items are *Never, 1 or 2 times, 3 to 5 times,* and *More than 5 times*. The subtle changes are necessary in order to determine what is actually happening at the course level (Ouimet & Smallwood, 2005; Reid, 2012; Smallwood & Ouimet, 2009). In developing the CLASSE, Ouimet and Smallwood focused on items from NSSE that were based on Chickering and Gamson's (1987) Seven Principles for Good Practice in Undergraduate Education (Ouimet, 2011). The CLASSE Student instrument asked students to reflect on their behavior regarding specific course activities. Students indicated the frequency of participation in specific activities that were classified as indicators of engagement. Examples of engagement indicators within the CLASSE Student instrument included participating in class discussions, working with other

students to complete projects, presenting to the class, applying concepts to practical problems, amount of time preparing for class, and the number of absences during the semester. Additionally, the CLASSE Faculty instrument asked faculty to rate the value they place on the same engagement-related activities. Both surveys included 41 items among five constructs, including: 1) engagement activities (n = 19), 2) cognitive skills (n = 5), 3) other educational practices (n = 10), 4) class atmosphere (n = 4), and 5) demographics (n = 3). The student version of the instrument included an open-ended section which allowed students the opportunity to provide additional comments.

CLASSE is a localized engagement survey derived from NSSE, thusly it is governed by the NSSE as well as The Trustees of Indiana University. Therefore, the first step in utilizing the CLASSE required determining the institutional eligibility. This was achieved by reviewing the most recent administration of the NSSE at Iowa State University. To be eligible to utilize the CLASSE, an institution must have administered the NSSE within the last three years. At the time of examining eligibility, Iowa State was deemed eligible due to NSSE participation in 2011, 2013, and 2016 ("Participating Institutions," 2016). The CLASSE Student was administered to all students enrolled in AgEdS 450 during the fall 2015 (N = 61) and spring (N = 60). The fall administration yielded an 88.5% (n = 54) response rate and the spring iteration yielded an 86.6% (n = 52) response rate. Accounting for both semesters of administration, the total response rate was 87.6% (n = 106). No efforts beyond the initial administration were attempted based on a response rate greater than 85% (Lindner, Murphy, & Briers, 2001). Additionally, the applied purpose of the data was to inform practice within the given course, an 87.6% response rate was deemed acceptable by the researchers. The CLASSE Faculty instrument was administered to all individuals involved in planning, delivering, or approving curriculum (instructor, farm operator,

and the professor-in-charge) within the course (N = 3) and yielded a 100% response rate prior to the start of the 16-week course. Measures of central tendency (i.e., means and standard deviations) for the CLASSE Student and CLASSE Faculty responses were calculated with SPSS 19.0. The means for the CLASSE Student instrument were then compared to CLASSE Faculty instrument means in a 2x2 quadrant analysis (Ouimet, 2011, Smallwood, 2010). Figure 2 depicts the quadrant descriptions and their corresponding statistical thresholds.

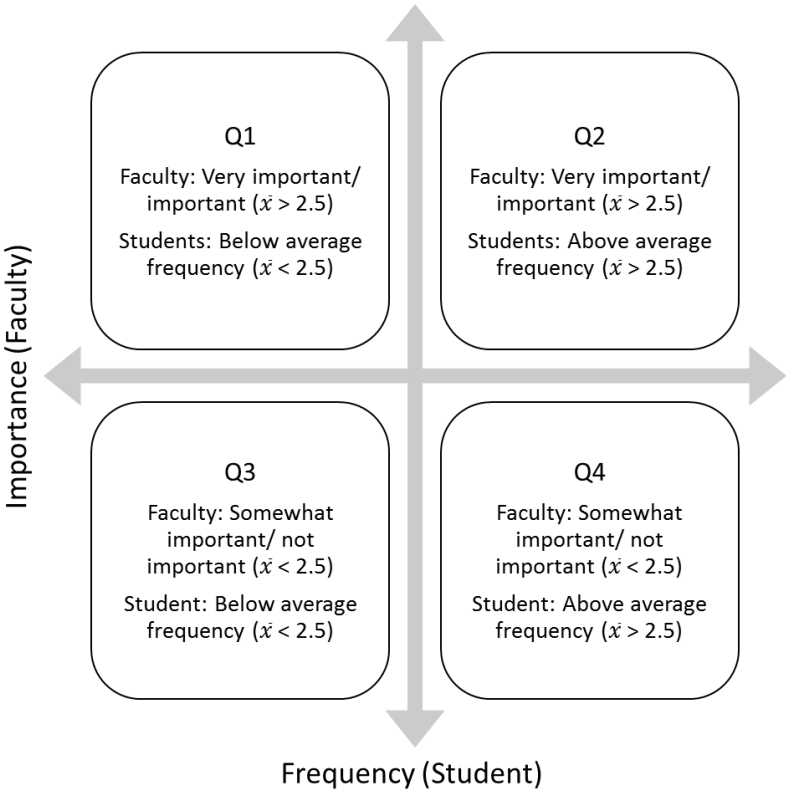

Figure 2. Diagram of the 2 x 2 quadrant analysis. Adapted from "Assessment Measures: CLASSE–The Class-Level Survey of Student Engagement," by J. A. Ouimet and R. A. Smallwood, 2005, Assessment Update, 17, p. 15. Copyright 2005 by John Wiley & Sons, Inc.

Items in the top left quadrant (Q1) were rated very important or important by faculty but student responses indicated a below average frequency of participation in activities related to student engagement. Items in the top right quadrant (Q2) were rated as very important or important by faculty and reported by students as having above average participation in those

engagement related activities. The lower left quadrant (Q3) contained items instructors rated as somewhat important or not important with students reporting below average participation in those activities. Quadrant four (Q4), the lower right quadrant, housed items rated somewhat important or not important by faculty and had above average participation per student reports. Q1 and Q4 are known as *misses*, as they show discrepancies between faculty rated importance and student frequencies; while Q2 and Q3 are known as *hits*, which show congruency between what faculty reports compared to what students reported doing.

Bempechat and Shernoff (2012) noted the difficulty that arises in attempting to measure student engagement through observer ratings, as it isn't always an observable characteristic. Thus, student self-reported data was utilized based on its practicality and its ability to measure non-observable indicators of engagement (Mandernach, 2015). Instructors of the course studied are the primary beneficiaries of the results, however results from this study could also provide valuable insight to engagement levels in a flipped, TBL-formatted course. It should be noted that the data presented here is representative of a homogenous population in regards to educational degree pursuit. Additionally, no specific data is available regarding the psychometric properties of CLASSE. According to Carle, Jaffee, and Miller (2009), the limited between-survey differences (NSSE and CLASSE) should result in similar reliability coefficients noted by Kuh (2001) which ranged from 0.85 to 0.90.

Results

The purpose of this study was to determine congruency between student participation in engagement-specific activities and instructors' perceived value of those same engagement practices within the capstone AgEdS 450 Farm Management and Operation course. The majority of respondents were male (78.3%) in their senior year (73.6%). All of the respondents were

pursuing an Agricultural Studies degree (100%), with six (5.7%) and one (0.9%) pursuing minors in Agronomy and Agricultural Education, respectively.

Research Objective One

Research objective one sought to describe the instructor-rated importance of specific activities linked with good practice (i.e., engagement indicators) in the AgEdS 450 course. Measures of central tendencies (means and standard deviations) are reported for each item by section to describe the importance placed on each activity by individuals with educative responsibilities within AgEdS 450. Relating to engagement activities, instructors unanimously rated the following six items as very important (M = 4.00, SD = 0.00) for students to be successful in AgEdS 450; integrating information from various sources into projects or papers, completing assignments or readings before coming to class, working with other students during class, putting ideas from other courses together during class discussions, presenting to the class, and receiving prompt written/oral feedback on academic performance. The lowest rated item, regarded as somewhat important (M = 2.00, SD = 1.00), was the need for students to discuss ideas from the class or related readings with instructors outside of class time. Table 1 displays all items within the engagement activities construct.

Table 1
Importance of Engagement Activities by Instructors in AgEdS 450 (N = 3)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Work on a paper or a project in your AgEdS 450 class that requires integrating ideas or information from various sources	4.00	0.00	4.00	4.00
Come to your AgEdS 450 class having completed readings or assignments	4.00	0.00	4.00	4.00
Work with other students on projects during your AgEdS 450 class	4.00	0.00	4.00	4.00
Put together ideas or concepts from different courses when completing assignments or during class discussions in your AgEdS 450 class	4.00	0.00	4.00	4.00
Make a class presentation in your AgEdS 450 class	4.00	0.00	4.00	4.00
Receive prompt written or oral feedback from you on their academic performance in your AgEdS 450 class	4.00	0.00	4.00	4.00
Ask questions during your AgEdS 450 class	3.67	0.57	3.00	4.00
Contribute to class discussions that occur during your AgEdS 450 class	3.67	0.57	3.00	4.00
Discuss grades or assignments with you as the instructor of your AgEdS 450 class	3.67	0.57	3.00	3.00
Prepare two or more drafts of a paper or assignment in your AgEdS 450 class before turning it in	3.33	0.57	3.00	4.00
Tutor or teach other students in your AgEdS 450 class	3.33	0.57	3.00	4.00
Use email to communicate with you as the instructor of your AgEdS 450 class	3.33	1.15	2.00	4.00
Work harder than they think they can to meet your standards or expectations in your AgEdS 450 class	3.33	0.57	3.00	4.00
Work with classmates outside of your AgEdS 450 class to prepare class assignments	3.00	1.00	2.00	4.00
Use an electronic medium (list-serv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment in your AgEdS 450 class	3.00	1.00	2.00	4.00
Discuss ideas from your AgEdS 450 with others outside of class (students, family members, coworkers, etc.)	3.00	1.00	2.00	4.00
Include diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments in your AgEdS 450 class	2.67	0.57	2.00	3.00
Participate in a community-based project (e.g., service learning) as part of your AgEdS 450 class	2.67	1.15	2.00	4.00
Discuss ideas from your AgEdS 450 readings or classes with you outside of class	2.00	1.00	1.00	4.00

Note. CLASSE Faculty used a four point scale: 1 (not important), 2 (somewhat important), 3 (important), and 4 (very important)

Instructors rated applying theories (*M* = 4.00, *SD* = 0.00) to practical problems as the most important cognitive skill students should employ in order to be successful in AgEdS 450. Conversely, rote memorization was considered least important (*M* = 2.00, *SD* = 1.00) for student success (Table 2).

Table 2
Importance of Cognitive Skills by Instructors in AgEdS 450 (N = 3)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Applying theories or concepts to practical problems or in new situations	4.00	0.00	4.00	4.00
Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	3.67	0.57	3.00	4.00
Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships	3.67	0.57	3.00	4.00
Making Judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	3.67	0.57	3.00	4.00
Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	2.00	1.00	1.00	3.00

Note. CLASSE Faculty used a four point scale: 1 (not important), 2 (somewhat important), 3 (important), and 4 (very important)

Table 3 displays the importance instructors placed on engagement indicators within the other educational practices category. According to the instructors, homework that takes more than an hour to complete (*M* = 2.00, *SD* = 1.73) and attending review sessions (*M* = 1.67, *SD* = 0.57) are somewhat important or important, respectively, for students' success. Class attendance (*M* = 4.00, *SD* = 0.00) and being interested in the course material (*M* = 4.00, *SD* = 0.00) are very important for success in AgEdS 450.

Table 3
Importance of Other Educational Practices by Instructors in AgEdS 450 (N = 3)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Attend your AgEdS 450 class?	4.00	0.00	4.00	4.00
Are interested in learning the AgEdS 450 course material?	4.00	0.00	4.00	4.00
Are challenged to do their best work on the examinations they have in your AgEdS 450 class	3.67	0.57	3.00	4.00
Prepare written papers or reports of more than 5 pages in length in your AgEdS 450 class?	3.33	0.57	3.00	4.00
Participate in a study partnership with a classmate in your AgEdS 450 class to prepare for a quiz or a test?	3.33	1.15	2.00	4.00
Take notes in your AgEdS 450 class?	3.00	1.00	2.00	4.00
Review notes prior to the next scheduled meeting of your AgEdS 450 class?	3.00	1.00	2.00	4.00
Spend more than 3 hours during a typical week preparing for your AgEdS 450 class (studying, reading, doing homework or lab work, analyzing data, rehearsing, and other academic matters)?	2.67	0.57	2.00	3.00
Have homework assignments during a typical week in your AgEdS 450 class that take more than one hour each to complete?	2.00	1.73	1.00	4.00
Attend a review session or help session to enhance their understanding of the content of your AgEdS 450 class?	1.67	0.57	1.00	2.00

Note. CLASSE Faculty used a four point scale: 1 (not important), 2 (somewhat important), 3 (important), and 4 (very important)

All indicators within the classroom atmosphere category were rated as very important or important (see Table 4). Specifically, for students to be successful they should feel comfortable talking to the instructors ($M = 4.00$, $SD = 0.00$) and enjoy working with classmates ($M = 4.00$, $SD = 0.00$).

Table 4
Importance of Classroom Atmosphere by Instructors in AgEdS 450 (N = 3)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Being comfortable talking with you as the instructor of the AgEdS 450 class	4.00	0.00	4.00	4.00
Enjoying group work with their classmates in your AgEdS 450 class	4.00	0.00	4.00	4.00
Finding the course material in your AgEdS 450 class to be difficult?	3.33	0.57	3.00	4.00
Finding the lectures easy to follow in your AgEdS 450 class?	3.00	1.00	2.00	4.00

Note. CLASSE Faculty used a four point scale: 1 (not important), 2 (somewhat important), 3 (important), and 4 (very important)

Research Objective Two

Research objective two sought to determine the frequency in which students participated in empirically-supported, effective educational activities within AgEdS 450. Table 5 displays descriptive statistics for the frequency in which students participated in specific activities classified as engagement process indicators. On average, students reported working with classmates for projects during class (M = 3.87, SD = 0.36) and utilizing an electronic medium to discuss or complete AgEdS 450 related assignments (M = 3.58, SD = 0.70) most frequently. Conversely, students rarely (i.e., never/one or two times) came to class without completing readings or assignments (M = 2.10, SD = 0.79). Students also reported including diverse perspectives in class discussions or writing assignments (M = 2.31, SD = 0.84) and discussing ideas from the reading material utilized with the instructor outside of class time (M = 2.25, SD = 1.05) less frequently as well.

Table 5
Frequency of Student Participation in Engagement Activities (n = 106)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Worked with other students on projects during your AgEdS 450 class[a]	3.87	0.36	2.00	4.00
Used an electronic medium (list-serv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment in your AgEdS 450 class[a]	3.58	0.70	1.00	4.00
Asked questions during your AgEdS 450 class[a]	3.56	0.71	1.00	4.00
Made a class presentation in your AgEdS 450 class[b]	3.50	0.70	1.00	4.00
Received prompt written or oral feedback on your academic performance from your AgEdS 450 instructor[c]	3.41	0.37	1.00	4.00
Worked on a paper or a project in your AgEdS 450 class that required integrating ideas or information from various sources[a]	3.39	0.68	2.00	4.00
Put together ideas or concepts from different courses when completing assignments or during class discussions in your AgEdS 450 class[a]	3.32	0.79	1.00	4.00
Contributed to a class discussion that occurred during AgEdS 450 class[a]	3.29	0.80	1.00	4.00
Worked harder than you thought you could to meet your AgEdS 450 instructor's standards or expectations[c]	3.13	0.84	1.00	4.00
Discussed ideas from your AgEdS 450 with others outside of class (students, family members, coworkers, etc.) [a]	3.00	0.89	1.00	4.00
Used email to communicate with the instructor of your AgEdS 450 class[a]	2.83	0.87	1.00	4.00
Worked with classmates outside of your AgEdS 450 class to prepare class assignments[a]	2.76	0.94	1.00	4.00
Participated in a community-based project (e.g., service learning) as part of your AgEdS 450 class[b]	2.49	1.10	1.00	4.00
Prepared two or more drafts of a paper or assignment in your AgEdS 450 class before turning it in[a]	2.47	0.73	1.00	4.00
Discussed grades or assignments with the instructor of your AgEdS 450 class[a]	2.46	0.85	1.00	4.00
Tutored or taught other students in your AgEdS 450 class[a]	2.32	0.91	1.00	4.00
Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments in your AgEdS 450 class[a]	2.31	0.84	1.00	4.00
Discussed ideas from your readings or classes with your AgEdS 450 instructor outside of class[b]	2.25	1.05	1.00	4.00
Came to your AgEdS 450 class without having completed readings or assignments[a]	2.10	0.79	1.00	4.00

Note. The CLASSE Student Engagement Activities section utilized a variety of four point scales in order to appropriately address each item.
[a]1 (never), 2 (one or two times), 3 (three to five times), and 4 (more than five times). [b]1 (never), 2 (once), 3 (two times), and 4 (more than two times).

Table 6 presents the cognitive skills employed by students during the AgEdS 450 course. Students reported utilizing rote memorization (M = 2.29, SD = 0.88) less frequently than the application of theories or concepts to practical problems in new situations (M = 3.37, SD = 0.84).

Table 6
Frequency of Student Use of Cognitive Skills (n = 106)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
Applying theories or concepts to practical problems or in new situations	3.37	0.84	1.00	1.00
Making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	3.35	0.82	1.00	1.00
Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	3.03	0.66	1.00	1.00
Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships	3.02	0.76	1.00	1.00
Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	2.29	0.88	1.00	4.00

Note. CLASSE Student Cognitive Skills section used a four point scale: 1 (never), 2 (one or two times), 3 (three to five times), and 4 (more than five times)

The frequency of participation in activities in the other educational activities category are displayed in Table 7. Students reported being interested in learning the AgEdS 450 course material (M = 3.39, SD = 0.59) and writing papers/reports of more than five pages in length (M = 3.58, SD = 0.63). Students also reported rarely being absent from class (M = 1.38, SD = 0.52), reviewing notes prior to class (M = 1.53, SD = 0.60), and attending review sessions to enhance understanding of course material (M = 1.16, SD = 0.43) were participated in less frequently by students.

Table 7
Frequency of Student Participation in Other Educational Practices (n = 106)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
How often in your AgEdS 450 class have you been required to prepare written papers or reports of more than 5 pages in length?[a]	3.58	0.63	2.00	4.00
How interested are you in learning the AgEdS 450 course material?[f]	3.39	0.59	1.00	4.00
To what extent do the examinations in your AgEdS 450 class challenge you to do your best work?[b]	2.69	0.73	1.00	4.00
How often have you participated in a study partnership with a classmate in your AgEdS 450 class to prepare for a quiz or a test?[a]	1.94	0.97	1.00	4.00
In a typical week in your AgEdS 450 class, how many homework assignments take you more than one hour each to complete?[c]	1.92	0.51	1.00	4.00
In a typical week, how often do you spend more than 3 hours preparing for your AgEdS 450 class (studying, reading, doing homework or lab work, analyzing data, rehearsing, and other academic matters)?[d]	1.63	0.77	1.00	4.00
How frequently do you take notes in your AgEdS 450 class?[d]	1.59	0.80	1.00	3.00
How often do you review your notes prior to the next scheduled meeting in your AgEdS 450 class?[d]	1.53	0.60	1.00	3.00
How many times have you been absent so far this semester in your AgEdS 450 class?[e]	1.38	0.52	1.00	3.00
How often have you attended a review session or help session to enhance your understanding of the content of your AgEdS 450 class?[a]	1.16	0.43	1.00	3.00

Note. The CLASSE Student Other Educational Practices section utilized a variety of four point scales in order to appropriately address each item.
[a]1 (never), 2 (once), 3 (two times), and 4 (three or more times). [b]1 (very little), 2 (some), 3 (quite a bit), and 4 (very much). [c]1 (none), 2 (one or two), 3 (three or four), and 4 (five or more). [d]1 (never/rarely), 2 (sometimes), 3 (often), and (very often). [e]1 (none), 2 (one to two absences), 3 (three to four absences), and 4 (five or more absences). [f]1 (very uninterested), 2 (uninterested), 3 (interested), and 4 (very interested).

Within the classroom atmosphere category, students indicated the lectures in the course to be somewhat easy (M = 2.32, SD = 0.62) and that they were comfortable talking with the instructors of AgEdS 450 (M = 3.59, SD = 0.61). Table 8 displays each engagement indicator within the classroom atmosphere category.

Table 8
Frequency of Student Participation in Activities Contributing to the Classroom Atmosphere (n = 106)

			Range	
Engagement Indicators	*M*	*SD*	Min	Max
How comfortable are you talking with the instructor of your AgEdS 450 class?[a]	3.59	0.61	2.00	4.00
How much do you enjoy group work with your classmates in your AgEdS 450 class?[b]	3.35	0.73	1.00	4.00
How easy is it to follow the lectures in your AgEdS 450 class?[d]	2.70	0.83	1.00	4.00
How difficult is the course material in your AgEdS 450 class?[c]	2.32	0.62	1.00	3.00

Note. The CLASSE Student Other Educational Practices section utilized a variety of four point scales in order to appropriately address each item.
[a]1 (uncomfortable), 2 (somewhat uncomfortable), 3 (comfortable), and 4 (very comfortable). [b]1 (very little), 2 (some), 3 (quite a bit), and 4 (very much). [c]1 (easy), 2 (somewhat difficult), 3 (difficult), and 4 (very difficult). [d]1 (difficult), 2 (somewhat easy), 3 (easy), and 4 (very easy).

Research Objective Three

Determining congruencies and discrepancies between the rates in which students participated in specific activities and the value instructors placed on those activities was the intent of research objective three. For misses (discrepancies), Q1 enveloped 10 (26.3%) of the 38 engagement indicators while Q4 contained zero. For hits (congruencies), Q2 contained 24 (63.2%) of the 38 indicators while Q3 was comprised of four (10.5%) of the engagement indicators. Q2, the highest level of congruency, indicated that students reported participating in those activities at above average frequencies, and faculty rated those activities as very important or important. Items within Q2 included asking questions during class, contributing to class discussions, including diverse perspectives on writing assignments, integrating ideas or concepts from other classes for assignments, making judgments about the value of information and validity of sources, synthesizing and organizing ideas into more complex relationships, being comfortable talking with the instructors, and applying theories or concepts to practical problems. Q3 indicated the frequency in which students memorize facts in order to repeat them in the same

manner, attend review sessions, or spend more than one hour per week on homework assignments was low while concurrently being regarded as only somewhat important/not important by the instructors. Q1 reported items rated as very important/important by the instructors, but had below average student participation. Items within this quadrant included preparing two or more drafts of a paper or assignment before turning it in, including diverse perspectives (e.g., different races, religions, genders, etc.), tutoring other students, taking notes, reviewing notes, and finding the course material difficult. Table 9 displays all items and their respective quadrant.

Table 9

Quadrant Analysis of Student Participation and Instructor Importance of Engagement in Course Activities

Quadrant 1	Quadrant 2
Faculty Rating: Very important/ important ($\bar{x}$ > 2.5) Student Report: Below average frequency ($\bar{x}$ < 2.5)	Faculty Rating: Very important/ important ($\bar{x}$ > 2.5) Student Report: Above average frequency ($\bar{x}$ > 2.5)
Prepared two or more drafts of a paper or assignment in your AgEdS 450 class before turning it in	Asked questions during your AgEdS 450 class
Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments in your AgEdS 450 class	Contributed to a class discussion that occurred during AgEdS 450 class
Tutored or taught other students in your AgEdS 450 class	Worked on a paper or a project in your AgEdS 450 class that required integrating ideas or information from various sources
Discussed grades or assignments with the instructor of your AgEdS 450 class	Came to your AgEdS 450 class without having completed readings or assignments
Participated in a community-based project (e.g., service learning) as part of your AgEdS 450 class	Worked with other students on projects during your AgEdS 450 class
In a typical week, how often do you spend more than 3 hours preparing for your AgEdS 450 class (studying, reading, doing homework or lab work, analyzing data, rehearsing, and other academic matters)?	Worked with classmates outside of your AgEdS 450 class to prepare class assignments
How frequently do you take notes in your AgEdS 450 class?	Put together ideas or concepts from different courses when completing assignments or during class discussions in your AgEdS 450 class
How often do you review your notes prior to the next scheduled meeting in your AgEdS 450 class?	Used an electronic medium (list-serv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment in your AgEdS 450 class
How often have you participated in a study partnership with a classmate in your AgEdS 450 class to prepare for a quiz or a test?	Used email to communicate with the instructor of your AgEdS 450 class
How difficult is the course material in your AgEdS 450 class?	Discussed ideas from your AgEdS 450 with others outside of class (students, family members, coworkers, etc.)
	Made a class presentation in your AgEdS 450 class
	Received prompt written or oral feedback on your academic performance from your AgEdS 450 instructor
	Worked harder than you thought you could to meet your AgEdS 450 instructor's standards or expectations
	Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components
	Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships
	Making Judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions
	Applying theories or concepts to practical problems or in new situations
	How often in your AgEdS 450 class have you been required to prepare written papers or reports of more than 5 pages in length?
	To what extent do the examinations in your AgEdS 450 class challenge you to do your best work?
	How many times have you been absent so far this semester in your AgEdS 450 class?
	How interested are you in learning the AgEdS 450 course material?
	How comfortable are you talking with the instructor of your AgEdS 450 class?
	How much do you enjoy group work with your classmates in your AgEdS 450 class?
	How easy is it to follow the lectures in your AgEdS 450 class?

Table 9 Continued	
Quadrant 3	Quadrant 4
Faculty Rating: Somewhat important/not important ($\bar{x}$ < 2.5) Student Report: Below average frequency ($\bar{x}$ < 2.5)	Faculty Rating: Somewhat important/not important ($\bar{x}$ < 2.5) Student Report: Above average frequency ($\bar{x}$ > 2.5)
Discussed ideas from your readings or classes with your AgEdS 450 instructor outside of class Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form In a typical week in your AgEdS 450 class, how many homework assignments take you more than one hour each to complete? How often have you attended a review session or help session to enhance your understanding of the content of your AgEdS 450 class?	

Conclusions and Discussion

This study showcased a useful heuristic for instructors to localize student engagement information. In an effort to rise to the call in developing engaging learning environments (Roberts et al., 2016), faculty members should consider utilizing the CLASSE to determine discrepancies in what students reported doing compared to what was valued by the instructor. The localization of engagement data can serve as a useful supplement to other course evaluations as well (Laird, Smallwood, Niskodé-Dossett, & Garver, 2009).

In objective one, instructors with educative responsibilities for the AgEdS 450 course provided the value (importance) placed on specific engagement activities. Aligning with the definition of a capstone course and the required learning activities in Crunkilton et al.'s (1997) framework, instructors rated integrating ideas and information from previous courses to in-class discussions and in completing assignments, projects, or papers as very important. Instructors also felt it was important for students to complete written reports, work with their peers, and communicate with the instructors. The utilization of higher order thinking skills was also regarded as important for students to be successful in the AgEdS 450 course.

For objective two, students reported their frequency of participation in specific engagement activities within the AgEdS 450 course. Students worked collaboratively to apply theories or concepts to practical problems, utilized technology to complete coursework, asked questions during class, and were interested in learning the course content. These items aligned with the outcomes and required learning activities recommended for inclusion in capstone courses according to Crunkilton et al. (1997). Student responses indicated an emphasis on the utilization of higher order cognitive skills as well as the perception of a safe classroom atmosphere.

Engagement is of paramount importance at all levels of education (Kuh, 2003). Therefore, activities empirically linked to student engagement (process indicators) (Chickering & Gamson, 1987; Kuh et al., 2007) are deserving of considerable attention in curriculum design. This study supported previous literature which found high levels of student engagement in active, TBL formatted courses (Lightner et al., 2007; Tucker, 2012). Our overall conclusion is that within a TBL-formatted capstone course, students engage in the learning process at high levels– both physically and psychologically–which leads to student development in several areas (Astin, 1999). Astin (1999) posited that all institutional practices are able to be evaluated based on the degree in which they increase or reduce student involvement. Contemplative of that statement, the TBL-formatted AgEdS 450 course was successful in fostering student involvement.

Recommendations and Implications

Information gleaned from instruments such as CLASSE has implications for capstone course instructors in higher education and can be useful in determining the benefits of new pedagogies highlighting various instructional innovations employed by instructors within colleges of agriculture (Maxwell, Vincent, & Ball, 2011). Additionally, this preliminary investigation offers initial insight on engagement promoted with a student-centered teaching approach; those needing validation as potential "…present day best practices and research-based pedagogies…" (Edgar et al., 2016, p. 39). As such, this study led to several recommendations for future inquiry.

The first recommendation stems from the importance of student engagement for long-term outcomes. It is suggested that a series of longitudinal studies be conducted to examine long-term outcomes as they relate to student involvement and engagement. These data could be useful

in validating Kuh et al.'s (2007) assertion that student engagement is linked to student satisfaction, employment, and lifelong learning skills. Furthermore, resulting data would be beneficial for colleges of agriculture in the promotion of and recruiting for various degree programs. The data could be utilized to inform potential students and various stakeholders about how engaging courses, departments, or entire degree programs are.

It is also recommended that a unified effort within agricultural education to develop a valid instrument for measuring student engagement at the local (classroom) level. As noted by Marx et al. (2016), much of the student engagement research is conducted at the institutional level. Research conducted at the institutional level provides many options in creating an empirically grounded instrument that can be psychometrically validated. The CLASSE may potentially provide a novel starting point. The effort should involve experts from across the discipline of agricultural education in an effort to address the multidimensionality of student engagement.

Finally, we suggest faculty members within agricultural education work to ensure students are actively involved in the learning process. This could be conceptualized through strategic course revisions or targeted professional development programs for faculty members (Balschweid et al., 2013; Blickenstaff et al., 2015). Astin (1999) noted that involvement theory emphasizes students actively participating in the learning process. Idealistically, these course revisions or professional development programs would contribute to a decrease in faculty reporting lecturing as the teaching modality in which they feel most efficacious (Harder et al., 2009; Stedman et al., 2011; Wardlow & Johnson, 1999). Course activities planned with active learning strategies should promote student engagement (Estepp & Roberts, 2013), a known indicator of long-term outcomes (Kuh et al. 2007). Perhaps meaningful, engaged, learning in all

environments can become a reality across the discipline with the adoption of student-centered teaching methods; teaching methods that emphasize the active application of content through structured problem solving and decisions making activities by students.

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CHAPTER VI. AN EXPLORATION OF STUDENT COLLABORATION NETWORKS IN A TEAM-BASED CAPSTONE COURSE

A paper prepared for submission to the *Journal of Agricultural Education.*

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Abstract

Learning is inherently a social act occurring through individualized interpretation and negotiations with diverse others. As such, the ability to work with others within the learning environment and beyond is an essential skill. Teaching methods that emphasize active learning in a team setting have garnered much support across higher education. Recently, the capstone farm management course, AgEdS 450, at Iowa State University was redesigned to further emphasize teamwork amongst students. Team-Based Learning (TBL) was incorporated within the capstone framework to promote higher levels of student collaboration, particularly for farm management decisions. TBL, a flipped, student-centered teaching method, promotes higher-order thinking, and the application of course content in a real world situation. For AgEdS 450, an actual farm serves as the applied learning laboratory where students make all decisions concerning its management and operation. This descriptive study sought to explore the collaboration networks of students enrolled in the fall 2015 (n = 61) and spring 2016 (n = 60) AgEdS 450 course. Social network analysis methods were utilized to construct and analyze student collaboration networks. Data were collected at the beginning, midpoint, and end of a 16-week semester in order to track development and/or growth of the collaboration network. The collaboration networks developed into cohesive structures encompassing all students within the course. With the increased interest in fostering teamwork in preparing students for careers, these results provide justification for the continued utilization of TBL. Further analysis of the TBL

method is warranted with particular attention to long-term outcomes and skill attainment. It is recommend that TBL be implemented in other courses within colleges of agriculture to further examine its utility.

Keywords: collaboration, social network analysis, team-based learning, capstone course

Introduction and Literature Review

The educational landscape is rapidly changing. More emphasis is now bestowed upon learning instead of teaching (Neo & Neo, 2009). This shift to a focus on the learning process subsequently requires more collaboration among students to solve complex problems (Hoppe & Reinelt, 2010). As higher education prepares students for the workplace, teamwork, touted as an essential trait for graduates entering the workforce (Espey, 2010; Lamm, Carter, & Melendez, 2014; Lamm, Carter, Stedman, & Lamm, 2014), has been granted special consideration in course design (Han, McCubbins, & Paulsen, 2016; Mars, 2015). Teamwork/collaboration, effective communication skills, critical thinking abilities, and problem-solving skills have been identified by employers' as skills most desired of a four-year educational program (Casner-Lotto & Barrington, 2006; Rateau, Kaufman, & Cletzer, 2015).

Several of the aforementioned employability skills can enhance or reinforce other skills. For example, critical thinking abilities can be strengthened through communication and collaboration within the learning environment. Smith (1977) found that student–student interaction led to positive and consistent gains in students' critical thinking; a desired outcome emphasized in higher education (Rhodes, Miller, & Edgar, 2012). Totten, Sills, Digby, and Russ (1991) suggested that collaboration allows students to become critical thinkers by engaging in discussion and taking responsibility for their own learning. With the recent interest concerning students' critical thinking abilities within the agricultural education literature (Davis & Jayaratne,

2015; Perry, Retallick, & Paulsen, 2014; Perry, Paulsen, & Retallick, 2015; Ricketts & Rudd, 2005; Velez, Lambert, & Elliott, 2015), effective communication and collaboration in the learning environment is paramount for student success (Wagner, 2008).

Through examination of the in-service training needs of secondary teachers of agriculture, Davis and Jayaratne (2015) found that teachers perceived instruction grounded in real-world scenarios, working with others, and emphasizing higher order thinking skills (e.g., critical thinking) as important for effective teaching in the 21st century. Similarly, Wells et al. (2015) suggested a concerted professional development effort for secondary teachers of agriculture to ensure students acquire 21st century skills such as critical thinking. The importance of critical thinking as well as other 21st century skills within agricultural education has also been found throughout the literature with a post-secondary focus (Burbach, Matkin, Quinn, Searle, 2012; Lamm et al., 2012; Perry et al., 2014, 2015; Rhodes et al., 2012).

Focusing specifically on critical thinking, Perry et al. (2015) concluded that enrollment in an experiential-based capstone farm management course reinforced specific critical thinking abilities. Specifically, the capstone course in his study employed discussion, written and oral communications, and issue analyses in developing critical thinking skills. The emphasis of these employability skills in higher education curriculum is needed, particularly if students are to be prepared for an evolving workforce (Rateau et al., 2015).

The ability to contribute effectively to a team can be cultivated by instructors through the emphasis of team-based or collaborative activities (Espey, 2010). Interestingly, when examining student values in regards to teams, Espey (2010) found that older students held less favorable views of collaborative learning activities, possibly due to previous experiences in group settings. In an effort to promote collaboration between agricultural science teachers and extension

educators, Murphrey, Harlin, and Rayfield (2011) noted the importance that should be placed on examining the organization's role in facilitating or hindering collaboration between individuals. Murphrey et al. stated "successful collaboration ultimately rests upon the commitment of individuals and the willingness for these individuals to work together and *collaborate* [emphasis in the original] with one another" (p. 38).

Social Network Analysis

While the previously mentioned research contributes to the knowledge base of agricultural education, it also illuminates the continued neglect of relational information in favor of examining strictly conceptualized behavior (Carolan, 2013). This issue is surmounted through the use and application of Social Network Analysis (SNA). "SNA, with its corresponding computer software, has allowed researchers to determine more relational information and contribute deeper insights to observe, explain, and predicate subjects' behaviors or thoughts within social networks" (Han et al., 2016). SNA allows for relational information (e.g., collaboration) to be measured and visualized; a useful mechanism for determining student–student interaction. Adopting SNA provides a manner in which the exchange of resources among actors (i.e., individuals, groups, or organizations) in a set boundary can be examined (Haythornhwaite, 1996). Indeed, SNA is not merely a set of research methods. SNA, through a set of theories, tools, and mathematical algorithms, allows researchers to examine relationships and structures embedded within a network (Hoppe & Reinelt, 2010). Especially useful when examining large networks, specific SNA tools allow for network data to be visualized on a graph. "Seeing the network can provide a qualitative understanding that is hard to obtain quantitatively" (Borgatti, Everett, & Johnson, 2013, p. 100).

Limited literature exists concerning SNA within agricultural education settings. In regards to examining social networks within Agricultural Education, Roberts, Murphy, and Edgar (2010) explored the interactions among student teachers during their student teaching experience. Roberts et al. found that the networks did not support defining the group of student teachers as close knit, although they did engage in various types of interaction with one another. This is unfortunate as Roberts et al. noted the importance of social interaction for learning, especially during a student teaching experience. However, the study only examined the network at the end of an experience, which doesn't allow for exploring the growth of the network over time. This was realized and an analysis of the formation, growth/ change, and possible interventions to strengthen the overall network were established as areas for future inquiry (Roberts et al.). This recommendation was carried out in a different context by Han et al. (2016), who explored the change in the collaboration network in a capstone course measured at the midpoint and end of a semester.

Han et al. (2016) discovered that as the semester progressed in an undergraduate capstone course, inclusivity increased. That is, students collaborated more with one another (student–student interaction). Han et al. further postulated that the capstone course design and the learning activities implemented facilitated collaboration among the students. While SNA has been utilized for many years, it is still a novel method for researchers in agricultural education (Han et al.). Thusly, SNA appears to be an innovative approach for measuring teamwork/collaboration within a course that encourages and emphasizes student–student interaction. With SNA's novelty within agricultural education in mind, it is appropriate to discuss some concepts, definitions, and explanations offered by this approach.

The simplest network contains two actors, and a relationship that links them (Kadushin, 2012). Relational data is derived from contacts or connections between interacting actors (Scott, 2013). Relationships in networks can be classified as simple, directed, symmetric, and relationship through intermediary (Kadushin, 2012). Two actors in one location could define a simple relationship, where the relationship is not directed in any way. In a directed relationship, actor one *likes* actor two, however the feeling is not returned. A symmetric relationship occurs when actor one *likes* actor two and vice versa. Relationships through an intermediary occur when information flows from one actor to another, and eventually is passed on to an additional actor. The relationship is directional but is not reciprocal (Kadushin, 2012). Figure 1 displays the various types of relationships in SNA.

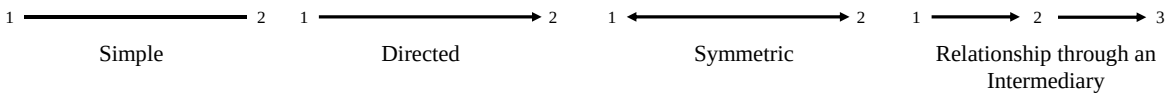

Figure 1. Types of relationships in SNA. Adapted from "Understanding Social Networks," by C. Kadushin, 2012.

Actors, or nodes, can be individuals, groups, or entire organizations, and are characterized by attributes (Borgatti et al., 2013). Attributes distinguish actors from one another, generally in a categorical way (e.g., gender, age, college major, or enrollment in a specific section of a course). Relational data is of particular importance to social network studies; advice giving, communication, and friendship ties being some of the most commonly studied relations within networks (Borgatti et al., 2013). Basic or applied network analyses are the two main approaches; where applied "…mean[s] that the study consists of calculating a number of metrics to describe the structure of the network or capture aspects of individuals' positions in the

network" (Borgatti et al., 2013, p. 6), while basic network analyses "…try to describe the variance in certain variables as a function of others" (p. 6).

The metrics utilized to describe the structural characteristics of networks are plentiful. Though the measures may seem simplistic; however, Hanneman and Riddle (2011) noted that measures are grounded with theoretical logic and empirical confirmation and they contribute significantly to the understanding of local and global networks. Common concepts and measures for describing networks are included in Table 1. Definitions were derived from the works of Borgatti et al. (2013), Hanneman and Riddle (2011), and Kadushin (2012).

Table 1
Definitions of Social Network Analysis Concepts and Measures

Concepts and Measures	Definition
Dyad	Two objects connected by some sort of relationship[a]
Triad	Network of three objects connected by relationships[a]
Size	The number of actors/nodes in a network[b]
Density	The proportion of all possible ties actually present in a network[b]
Reachability	Existence of a set of connections where every actor is connected to another, regardless of path length[b]
Connectedness	The proportion of pairs of nodes that can reach one another by a pathway of any length[c]
Geodesic Distance	Number of relations in the shortest pathway that connects two actors[b]
Eccentricity	An actor's largest geodesic distance[b]
Diameter	Largest eccentricity present in a network[b]
Compactness	A measure that weighs paths connecting nodes inversely by their length[c]
Reciprocity	Proportion of reciprocated ties to total number of ties[c]
Transitivity	Measure of the occurrence of transitive or intransitive triads[c]
Clustering	A set of actors judged to be similar on the basis of relational data[b]
Robustness	A measure of how many nodes need to be removed in order to disconnect the network[c]
Degree	Number of connections[c]
Indegree	Measure of ties sent from other actors to a target actor in directed networks[c]
Outdegree	Number of ties sent from target actors to other actors in directed networks[c]
Cohesion	The extent that actors within a network are connected[b]

Note: Common terms utilized in analyzing social networks. [a]Kadushin (2012); [b]Hanneman and Riddle (2011); [c]Borgatti et al. (2013).

Theoretical/Conceptual Framework

Bandura's (1977) Social Learning Theory (SLT) and Vygotsky's (1978) social constructivism served as the theoretical underpinnings of this study. Initial focus within Bandura's (1977) SLT framework focused on behaviors of the individuals, while social constructivism (Vygotsky's, 1978) focused mainly on cognition. Both theorists discuss the importance of interaction with others for individual development.

The coalescence of "…speech and practical activity, two previously completely independent lines of development…" (Vygotsky, 1978, p. 24) is the most significant moment in intellectual development. Doolittle and Camp (1999) identified social constructivism on the continuum of constructivism. Learners construct meaning from their experiences and constructivism acknowledges the active role students (individually and socially) take in the creation of knowledge (Doolittle & Camp, 1997; Fosnot, 2005). Prawat and Flodden (1994) noted that "…knowledge evolves through a process of negotiation within discourse-communities and that the products of this activity… are influenced by cultural and historical factors" (p. 37). The influence of cultural and historical factors in knowledge creation highlight the interplay of the individuals' contribution to the social aspect of creating knowledge. It is important to note the existence of two distinct interpretations of negotiation adopted by social constructivists (Prawat, 1989).

One position views negotiation as a process of compromising or consensus building among individuals while the other position views negotiation as a method to skillfully overcome obstacles (Prawat & Flodden, 1994; Prawat, 1989; Roby 1988). The compromise view of negotiation "…suggests knowledge can be created through consensus or a type of bargaining process in the classroom" (Prawat, 1989, p. 321) but is contested because "compromise rarely

leads to insight; in fact, it can be argued, when reaching agreement is the overriding goal, important differences are often papered over or ignored" (Prawat & Flodden, 1994, p. 40). The view of negotiation as overcoming obstacles likens an educator's role to that of a facilitator; a facilitator who aids students in traversing the educational landscape while pointing out the "…aspects of the terrain that are most likely to impede the group's progress. In the classroom, this would involve probing the limits of students' understanding with difficult cases…" (Prawat & Flodden, 1994, p. 40). Roby (1988) explained this process as one in which students develop diverse viewpoints worthy of exploration instead of a competitive viewpoint where others need to be eliminated; thus creating a need for a collaborative learning environment where students may work together in creating meaning from their experience.

Roberts, Edgar, and Murphy (2010) described the social nature of learning by stating, "The dynamic process of knowledge acquisition relies on social interactions to clarify knowledge and process experiences" (p. 113-114). Knowledge is a social product that is created and shared within communities (Mercer & Howe, 2012). Supportive of Social Learning Theory (Bandura, 1977), the interaction within the learning environment is viewed as the interplay of behavior, personal factors, and environmental factors, further explained as "…interlocking determinants of each other" (p. 10). Bandura (1977) noted the varying degrees of influence these factors have in different situations. In one situation, personal factors may exert more influence over the environmental or behavior factor, while other situations may lead to the environment exerting more influence, and so on. The effects of social interaction may have lasting impacts on long term outcomes and student success. An important aspect to Bandura's (1977) Social Learning Theory is the emphasis of self-regulation, explained "by arranging environmental inducements, generating cognitive supports, and producing consequences for their own actions, people are able

to exercise some measure of control over their own behavior" (Bandura, 1977, p. 13). The environmental inducement in the present study is the structure of AgEdS 450 in TBL format.

AgEdS 450 and Team-Based Learning

AgEdS 450, a capstone farm management course, is by nature, social. The course has been designed to foster teamwork and collaboration in several ways. The instructional approach itself, as well as assignments, were designed to allow students to work together to solve problems (Andreasen & Trede, 2000; Paulsen, 2010). A brief history of the course, supported by existing literature on the actual course, and the current layout, as described by the researchers' experience in the course redesign is appropriate. The course, beginning in 1943, was developed in order to provide students with practical experience in making farm management decisions (Murray, 1945). The students were tasked with making all decisions as it related to an actual farm, and did so through the analysis of available data and official business meetings (Murray, 1945).

Wallace (1963) noted the power of peer influence within the course and that each decision was subjected to sound justification and presentation of the reasoning and supporting evidence to other class members. Learning to deal with consequences of decisions enhanced the educative power of the course; students had to deal with decisions that had negative consequences such as the installation of a lane fence in a hay field that had to be removed in order for the hay wagon to make a turn. While the fence was approved by a majority vote after presentation of the plan and justification for its installation, it ended up being a poor decision but a powerful lesson (Murray, 1945). Students were required to synthesize decisions from each year and present to course alumni in an effort to keep them up-to-date on the progress of the farm. This synthesis was also paired with a farm field day where all course alumni were invited to visit

the farm and see how the previous decisions impacted the farm (Wallace, 1963). Students in the AgEdS 450 course have been tasked with working together to make sound management decisions, as the farm was expected to be a self-sustaining entity (Murray, 1945; Wallace, 1963).

Teamwork/collaboration has long been a staple of the course design. With the emphasis on teamwork/collaboration to manage a real farm, Honeyman (1985) stated:

> During the discussions, students often learned from each other. New ideas and original approaches were gained through interaction with those of differing backgrounds or experiences. Frequently students often came to know their Ag 450 classmates better than those in any other college course (p. 56).

Echoing an assertion from Honeyman (1985), Trede, Soomro, and Williams (1992) concluded the use of a farm laboratory contributed most to the effective teaching of the course, and that students developed deep interpersonal relationships. In a follow-up study of course alumni, Andreasen and Trede (2000) found that student-student interaction in the AgEdS 450 course far exceeded the student-student interaction in similar capstone courses. From inception to present, the social aspect of learning has seemingly contributed to the delivery employed.

The importance of collaboration is further supported in Kuh's (2009) work on educational practices that are classified as high-impact as well as in Chickering and Gamson's (1987) seven principles of good practice in undergraduate education. Specific course design or teaching methodologies may prove to be an effective way to increase collaboration among students, as embedding employability skills can be done without compromising content (Knight & Yorke, 2002). Capstone experiences have been documented as effective in student development of teamwork/collaboration skills (Andreasen & Trede, 2000; Crunkilton, Cepica, & Fluker, 1997; Han et al., 2016; Honeyman, 1985; Paulsen, 2010; Perry et al., 2015; Trede &

Andreasen, 2000; Trede et al., 1992;); thusly, they are classified as a high-impact educational practice (Kuh, 2009). In an effort to further emphasize teamwork and collaboration, the AgEdS 450 course was recently restructured to a Team-Based Learning (TBL) format (McCubbins, Paulsen, & Anderson, in press).

TBL was developed in the late 1970s in an effort to ameliorate the effects of substantial growth in course enrollment (Michaelsen, Knight, & Fink, 2004; Michaelsen, Parmalee, McMahon, & Levine 2008; Michaelsen, Sweet, & Parmalee, 2011; Sibley & Ostafichuk, 2014). Michaelsen et al. (2004) explained TBL as a teaching method which emphasizes team problem solving and decision making through the application of course content. In this method, the time normally devoted to passive transmission of content is transformed into an active learning environment that provides ample opportunities for students to apply content to real world scenarios (Michaelsen et al., 2011; Sibley & Ostafichuk, 2014).

In TBL structured courses, students are responsible for engaging in introductory content before attending a class session, and further held accountable for their engagement with the content via an individual readiness assurance test (IRAT) (Michaelsen et al., 2008). An additional layer of accountability is introduced through the team readiness assurance test (TRAT), which allows students to collaborate and negotiate each question on the IRAT (Sibley & Ostafichuk, 2014). The TRAT is completed on an Immediate Feedback Assessment Technique ("What is the IF-AT?," n.d.) form that provides immediate feedback to the team. Teams, if they collectively agree, are able to appeal questions on the TRAT based on ambiguity in the question or other glaring errors within the assessment; however, the appeal must be based on written scholarly prose, and is not an opportunity to 'dig' for points (Michaelsen et al., 2004; Michaelsen et al., 2008; Michaelsen et al., 2011; Sibley & Ostafichuk, 2014). Any misconceptions regarding

the introductory content are addressed in a short, corrective instructional session (McCubbins, 2015). After this is completed, students spend the majority of class time applying the content to solve real-world problems and make informed decisions (Michaelsen et al., 2004). Student teams are intact for the duration of the semester so that they may transform into cohesive, high performing learning teams (Michaelsen et al., 2011; Sibley & Ostafichuk, 2014). McCubbins et al. (in press) postulated that capstone courses taught in a contextual setting would likely benefit from the adoption of a student-centered teaching method that emphasizes teamwork and collaboration.

Exploring and describing collaboration networks in an active, learner-centered classroom can provide valuable insight on how social structures form and the intensity that students engage in collaborative activities. As noted previously, teamwork/collaboration and communication are skills desired by employers; aside from the traditional behavioral conceptualizations of these skills, social network analysis, and visualizations of such concepts may provide ample evidence for adoption of a learner-centered approach within classrooms across the discipline.

Purpose and Objectives

Sociograms, developed through network analysis methods and viewed through a social constructivist lens, can provide insight on the intensity of the high-impact practice of collaboration within courses across higher education institutions. The purpose of this descriptive study was to explore the collaboration between students over the duration of a semester in a team-based learning formatted capstone course. Data collection included an initial, mid-point, and end-of-semester measure of reported collaboration. An apparent gap in the literature exists in terms of measuring student collaboration, especially through a multiple-measure approach. This study sought to explore the development of a collaboration network during a 16-week capstone

course that emphasized teamwork and communication (Crunkilton et al., 1997). Perry et al. (2014) declared a need for instructors within higher education institutions to utilize innovative teaching methods that target specific skills that aid in the development of critical thinking abilities. The apparent gap in the literature, the declaration from Perry et al. (2014), as well as priority area four of the National Research Agenda: Meaningful, Engaged Learning in All Environments (Edgar, Retallick, & Jones, 2016) provides support for the need to investigate collaboration networks among students. The following research questions guided this study:

1. What does a collaboration network map look like in a team-based learning formatted course?
2. Does the collaboration network map change over the course of the semester?
3. Did the collaboration network become more inclusive?

Methods and Procedures

Design and Population

This study was part of a larger research study that sought to examine the effectiveness of the TBL pedagogical practice in an undergraduate capstone course from multiple perspectives. The present study sought to explore and describe the development of, and potential growth of social networks in a TBL formatted capstone course. SNA studies are often developed in three stages (Kapucu, Yuldashev, Demiroz, & Arslan, 2010; Scott & Carrington, 2011; Springer & de Steiguer, 2011). This study, employing a non-experimental design, followed the aforementioned stages and included; 1) identifying the network, 2) collecting social interaction data, and 3) analyzing the resulting data. A full network, position-based approach, as outlined by Laumann, Marsden, and Prensky (1983), was utilized to define the boundary of the network. Since the target population consisted of students enrolled in the AgEdS 450 course during the fall 2015 (*n*

= 61) and spring 2016 (*n* = 60) semester, a census was conducted and served as the boundary definition of the network for each semester. Network diagrams were created for each time point of data collection for each semester. The resulting networks were analyzed independently as the interest was focused on the growth and development of the networks within the TBL formatted course.

Instrumentation

Data were collected on a researcher-created, paper-based, sociometric questionnaire (Moreno, 1953). The survey included selected demographic data (i.e., team number, age, lab section, major, class status, and committee), a class roster, and instructions on filling out the instrument. The class roster was distributed amongst three rows, in alphabetical order. Participants were instructed to identify only students with whom they had collaboratively worked, and to rate that level of collaboration. Previous relationships were not of interest in the current study, therefore students were instructed to only rate the collaboration with other students during this specific course. The levels of collaboration were summarized on a five-point scale ranging from no collaboration to high-level collaboration. In order to assess the growth and development of any resulting network, a semester-long multipoint assessment was conducted with the sociometric survey. The sociometric survey was distributed after the first week of the course, at the mid-point, and again during the last week of the 16-week semester. This was repeated for both fall 2015 and spring 2016 semesters. Response rates for the fall 2015 (*n* = 61) and spring 2016 semester (*n* = 60) were 100% (*N* = 121).

Figure 2 depicts the student response options for reporting collaboration with other students. *No collaboration* was defined as not seeking information or input for various assignments or projects during the course. *Low level collaboration* was described as seeking

minimal information or input from others for assignments or projects while *high level collaboration* was defined by significant contributions of information or input from others for completion of assignments or projects. These definitions were reiterated at each point in the data collection process.

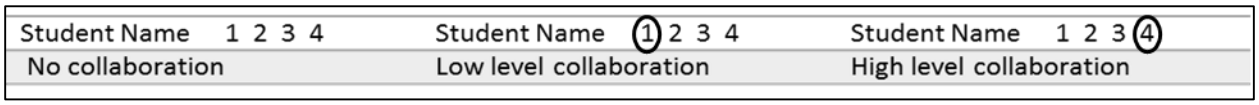

Figure 2. AgEdS 450 sociometric response options

Data Management

Before data analysis could be completed, reported data had to be coded, and input into a social network matrix. Data management included alpha-numerically coding each individual student, and creating a full matrix including all reported relational data (i.e., collaboration). The first row and column identified the node and the information within the cells indicated a relation. The relational information can be binary (i.e., 1s and 0s) or valued (i.e., 0, 1, 2…), where binary data may indicate a relation or not and valued data may indicate a level of relations. For example, binary data could indicate that node A reports node B is a friend and would be indicated with a 1, while valued data could be measured by how often actors interact with others or how strongly they rate their friendship and be indicated with a predetermined measure (e.g., 1 = acquaintances, 2 = close friends, 3 = best friends). Symmetric matrices are those where the lower left section of the matrix mirrors the top right portion ($x_{i\,j} = x_{j\,i}$), while directed ties utilize an asymmetric matrix where $x_{i\,j}$ could equal $x_{j\,i}$ but does not have to (Borgatti et al., 2013). Figure 3 shows an example of a non-reflexive network matrix (Borgatti et al., 2013). For this study, the data were dichotomized before analyses were conducted for interpretability purposes. Descriptive statistics for explaining networks were performed in UCINET (Borgatti, Everett, & Freeman, 2002). Specific measures calculated included; density, average degree, average

geodesic distance, reciprocity, transitivity, blocks, cutpoints, diameter, and number of ties (actually present and total possible). Network visualizations were diagramed with NetDraw (Borgatti, 2002).

All procedures performed contribute to explaining the networks that emerged from each time point of relational data collected.

		Participants							
		A01	A02	A03	A04	A05	A06	A07	…
Participants	A01		0	1	1	0	0	0	
	A02	0		0	1	0	0	1	
	A03	1	1		0	0	0	0	
	A04	0	1	1		1	0	0	
	A05	0	0	0	0		0	1	
	A06	0	1	0	0	0		0	
	A07	0	1	0	1	1	0		
	…								

Figure 3. Sample adjacency matrix. Adapted from "Analyzing Social Networks," by S. P. Borgatti, M. G. Everett, and J. C. Johnson, 2013.

A separate matrix was created for the attribute data collected. The rows represented each actor while the columns represented specific attributes of each node. Figure 4 illustrates an attribute matrix and its components.

		Attributes						
		Team #	Age	Section	Major	Status	Committee	…
Participants	A01	1	22	1	1	3	1	
	A02	2	21	1	1	3	2	
	A03	3	25	1	1	4	1	
	A04	4	22	1	1	4	3	
	A05	5	21	1	1	3	5	
	A06	6	23	2	1	4	9	
	A07	7	21	2	1	4	10	
	…							

Figure 4. Sample attribute matrix. Adapted from "Analyzing Social Networks," by S. P. Borgatti, M. G. Everett, and J. C. Johnson, 2013.

As noted in Perry et al. (2015), the AgEdS 450 course structure is unique. Perry et al. contended that the course structure offers ideal conditions for experimental research design because the course has two laboratory sections. This can be argued for small-scale research. However, the entire class met in an on-campus facility for the lecture portion of the course on Tuesdays, which would introduce a serious threat of diffusion. Laboratory sections met separately on Wednesdays and Thursdays each week and consisted of roughly half of the students in each laboratory section. In an effort to promote collaboration as well as handle increasing enrollment, TBL was couched alongside the capstone course tenets expounded by Crunkilton et al. (1997). Figure 5 displays how the teams and committees were separated.

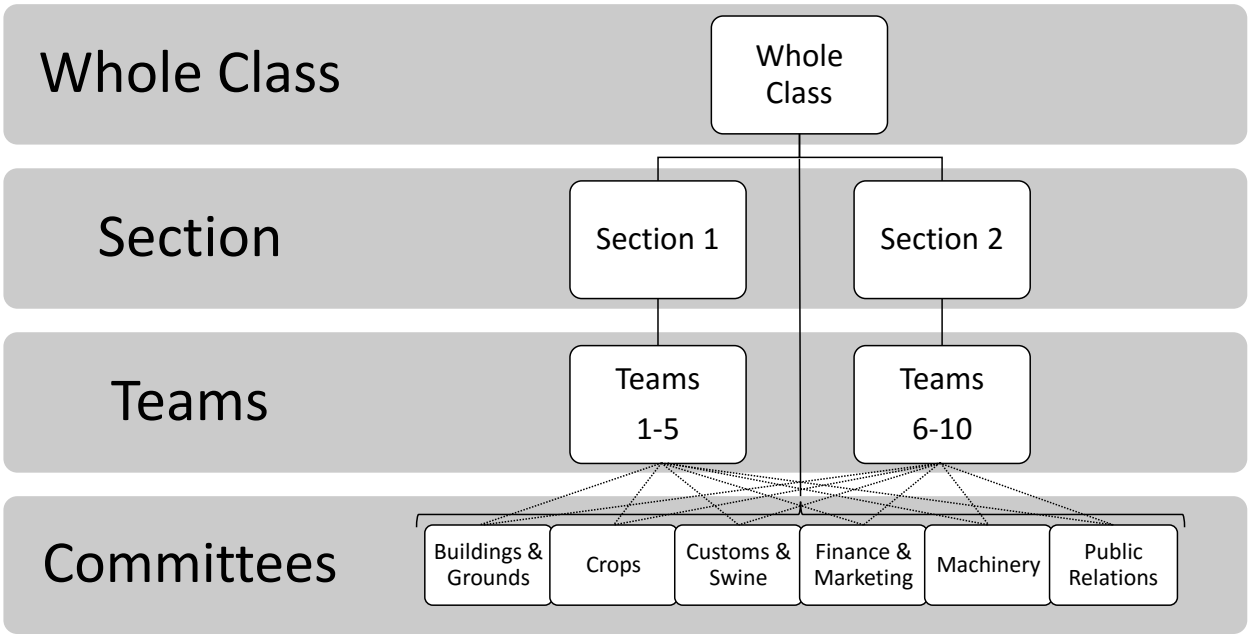

Figure 5. AgEdS 450 structure with teams and committees.

Each semester had 10 teams of five to seven students. Teams were selected via criterion-based measures in order to ensure a distribution of academic resources (e.g., academic performance, work experience, major, etc.). The teams were contained within sections, meaning teams one through five were in section one and team six through ten were in section two. To

encourage the formation of multiple networks and to promote exposure to several perspectives, teams determined committee representation. The committees represented the various enterprises found on the AgEdS 450 farm. Committees were distributed across sections. This layout allowed for half of each committee to be present on any given lab day. Importantly, teams made decisions regarding the management and operation of the farm while committees actually researched and carried out any decisions made. That is, if the teams decided to market grain, the finance and marketing committee would then be responsible for ensuring the execution of the contract.

Results

The following findings were derived from the sociometric responses of participants from the population studied. The findings are presented in two sections and describe the collaboration networks from fall 2015 and spring 2016 semesters. For each semester, whole network descriptions and diagrams are presented first, followed by team network descriptions and diagrams.

Fall 2015 Whole Network

Eighty percent (n = 49) of the students who participated in this study were male, and 20% (n = 12) were female. Section one of the separate labs, which housed teams one through five, contained 48% (n = 29) of the students while section two, which housed teams six through ten, contained 52% (n = 32) of the students. Agricultural studies was the academic major for 100% (N = 61) of the students in the population.

The first objective sought to determine the structure of a collaboration network map from a TBL formatted capstone course in AgEdS 450. Sociometric data for Round I (Figure 6), Round II (Figure 7), and Round III (Figure 8) are depicted in graphical form and provide a visualization of the relational structure of a collaboration network. The sociograms provide visual evidence of

an increase in the number of collaborative ties between all students in the course. The sociograms reveal no isolated individuals and appear more dense from round one to round three.

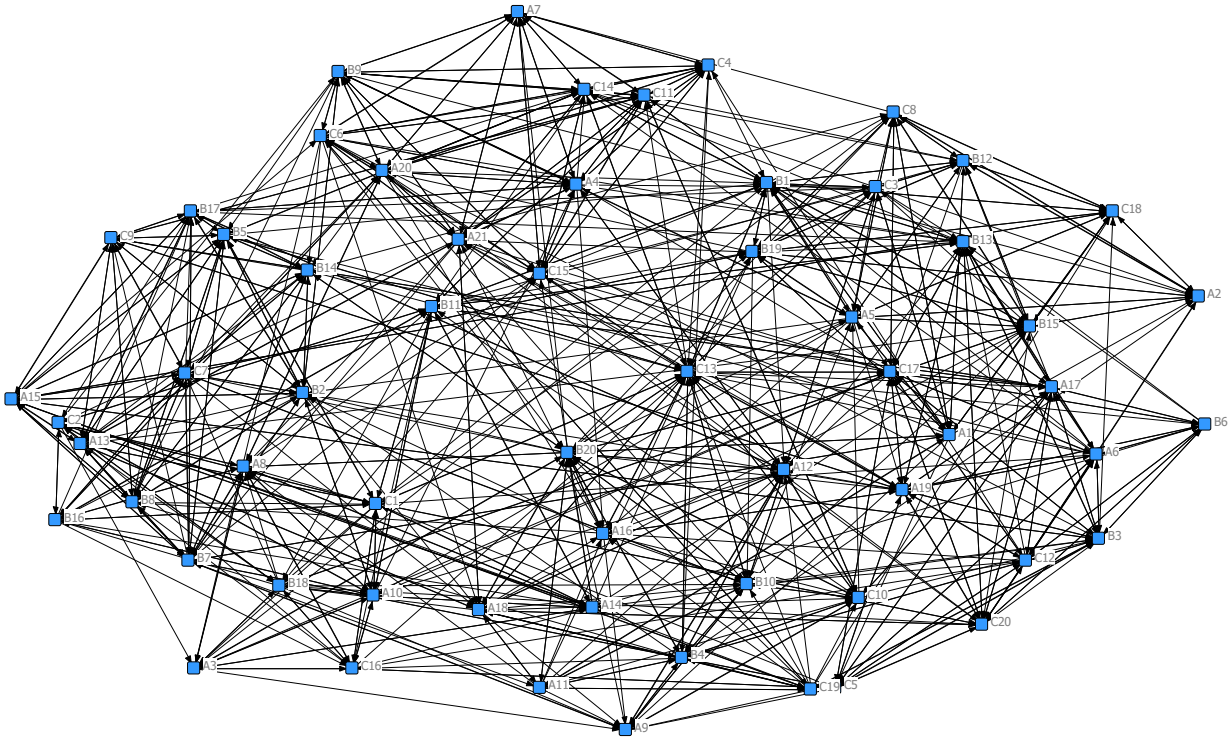

Figure 6. Fall 2015 Round I collaboration network.

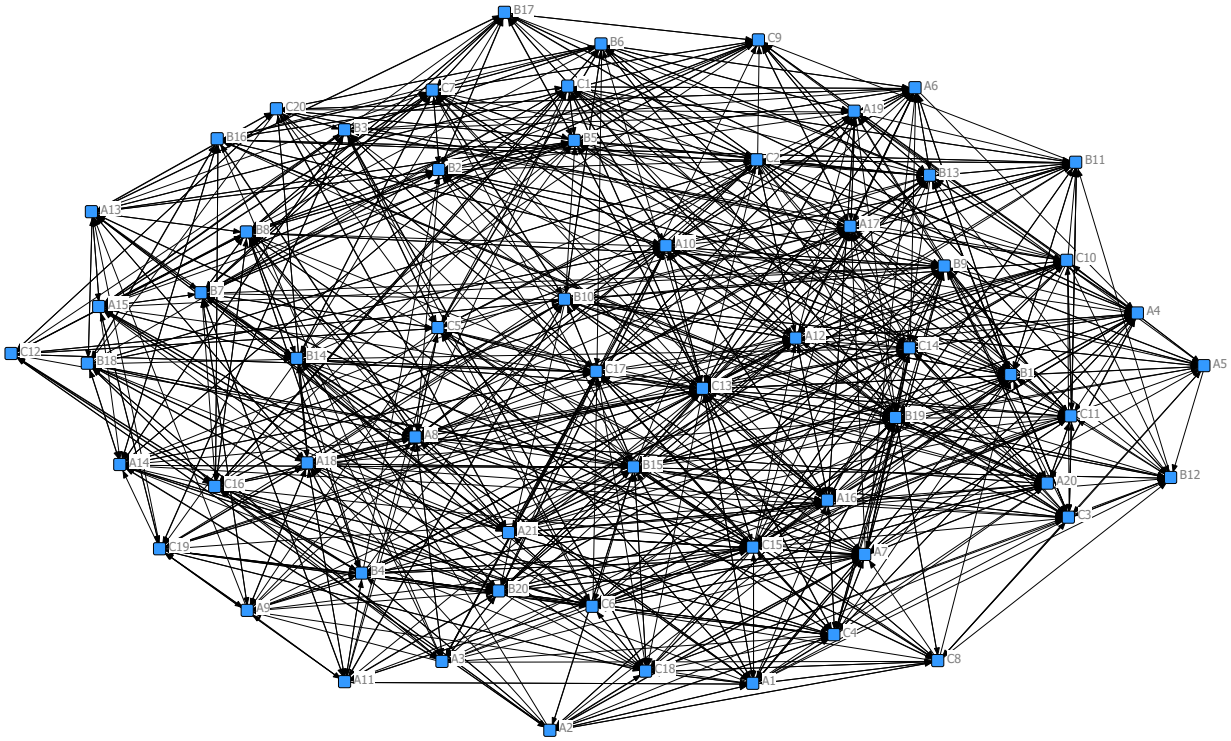

Figure 7. Fall 2015 Round II collaboration network.

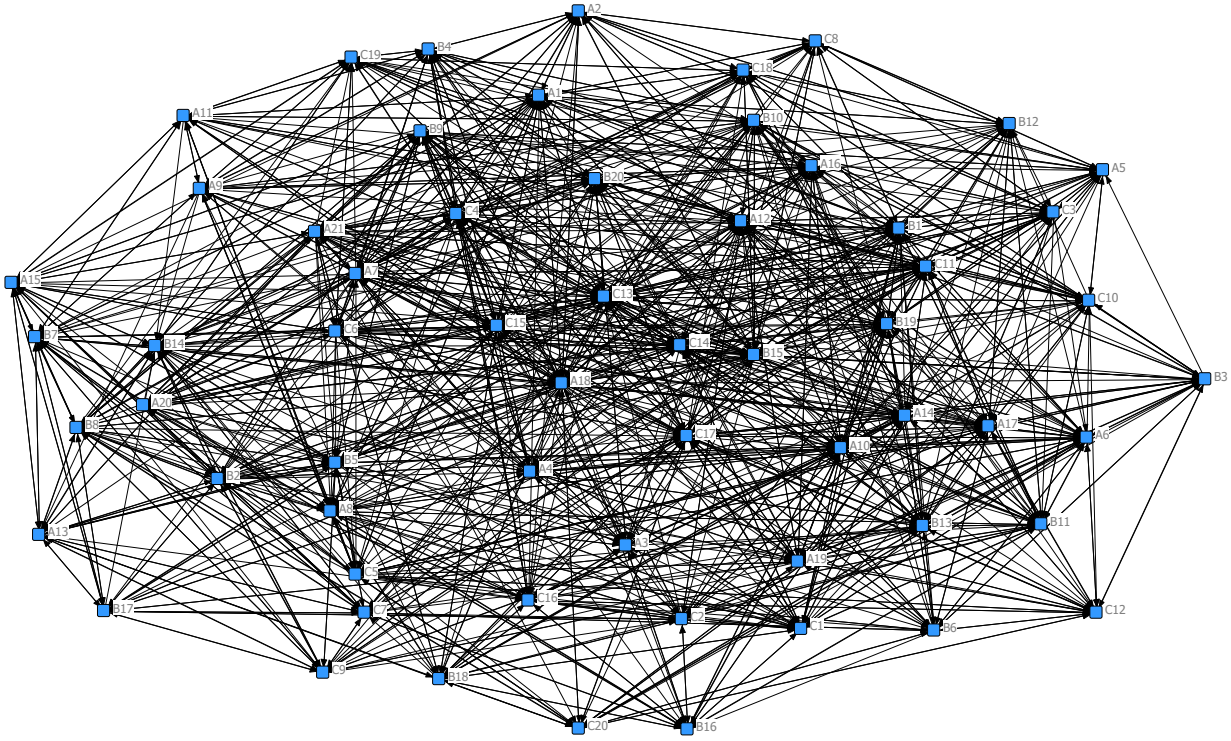

Figure 8. Fall 2015 Round III collaboration network.

Determining change in the collaboration network was the purpose of the second research objective. Whole network descriptive statistics were calculated as well as the percent change for each round of data collection descriptive statistics for the whole network and then calculating the percent change for specific network characteristics. Whole network descriptive statistics are provided in Table 2 while Table 3 highlights change percentages for the density, number of ties, average degree, and the average geodesic distance between actors. The density of the initial collaboration network was 0.21, representing 753 unique collaboration ties out of 3,660 possible ties. The density of the final collaboration network was .36, representing a 41.7% increase in the overall density of collaborative relations.

Table 2 displays the network properties for each round of data collection. The diameter, blocks, and cutpoints remained constant through each measure of collaboration at 3, 1, and 0, respectively.

Table 2
Collaboration Network Properties for Fall 2015

Measure	Round I	Round II	Round III
Density	0.21	0.27	0.36
Standard Deviation	0.40	0.44	0.48
Average Degree	12.3	16.2	21.4
Average Geodesic Distance	1.92	1.75	1.65
Standard Deviation	0.60	0.50	0.50
Reciprocity	0.58	0.55	0.57
Transitivity	0.14	0.13	0.19
Blocks	1	1	1
Cutpoints	0	0	0
Diameter	3	3	3
Number of Ties (Actual)	753	992	1306
Number of Ties (Possible)	3660	3660	3660

The density of collaboration ties for the whole network increased by over 70% while the average geodesic distance between actors experienced a continual decrease from the initial

measure to the final measure. In other words, the average number of pathways to connect a student to any other student was lowered, indicating a more collaborative network.

Table 3
Collaboration Network Change during Fall 2015

Measure	Percent Change		
	Round I to Round II	Round II to Round III	Overall
Density	28.6	33.3	71.4
Average Degree	31.7	32.1	73.9
Average Geodesic Distance	-8.8	-5.7	-14.1
Number of Ties (Actual)	31.7	31.7	73.4

Fall 2015 Team Network

Table 4 displays descriptive statistics for the team network for each round of data collection as well as the percent change of the team's collaboration ties densities. Each team had a positive change in density from Round I to Round II, which indicates that the teams collaborated more at the midpoint of the semester. Two teams experienced a decrease in within-team density from round two to round three, two teams had a decrease in the density of collaboration ties while two teams had no change in density. All ten teams ended the semester with an increase in the density of collaboration ties. Sixty percent (n = 6) of the ten teams experienced a 40% growth of within-team density of collaboration ties. The lowest growth in terms of percent change in density was 26.3% within team nine.

Table 4
Within-Team Collaboration Network Properties for Fall 2015

	Round I		Round II		Round III		Percent Change		
Team	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	12	0.40	26	0.87	24	0.80	54.0	-8.7	50.0
2	14	0.47	24	0.80	27	0.90	41.3	11.1	47.8
3	21	0.70	27	0.90	29	0.97	22.2	7.2	27.8
4	18	0.60	23	0.77	26	0.87	22.1	11.5	31.0
5	16	0.53	25	0.83	27	0.90	36.1	7.8	41.1
6	21	0.50	35	0.83	37	0.88	39.8	5.7	43.2
7	12	0.40	27	0.90	25	0.83	55.6	-8.4	51.8
8	18	0.43	28	0.67	32	0.76	35.8	11.8	43.4
9	14	0.70	19	0.95	19	0.95	26.3	0.0	26.3
10	19	0.63	27	0.90	27	0.90	30.0	0.0	30.0

Sociograms arranged by teams are presented for Round I (Figure 9), Round II (Figure 10), and Round III (Figure 11) and confirm the growth of collaboration among and between teams throughout the semester in AgEdS 450.

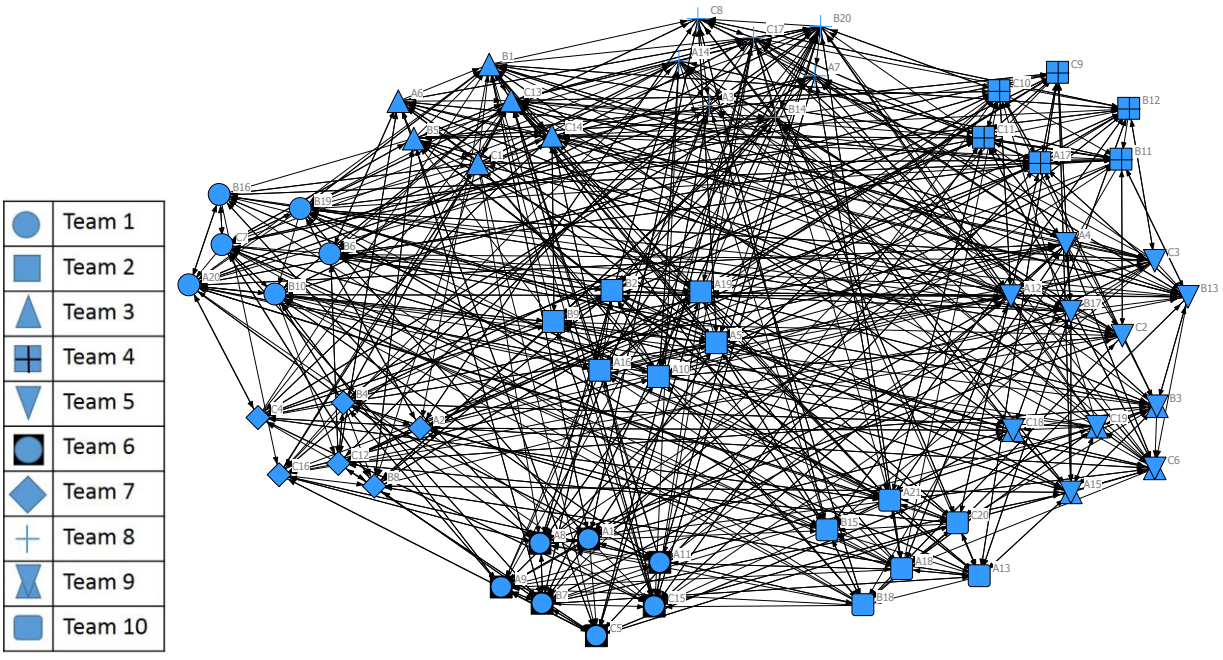

Figure 9. Fall 2015 Round I team collaboration network.

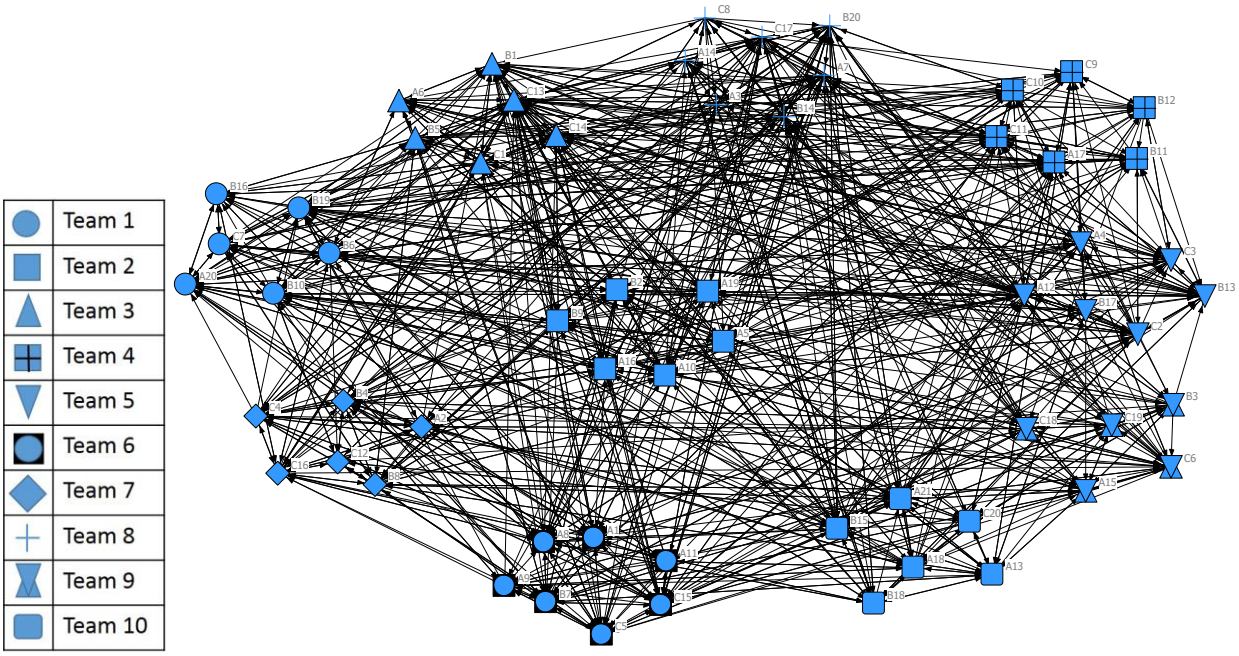

Figure 10. Fall 2015 Round II team collaboration network.

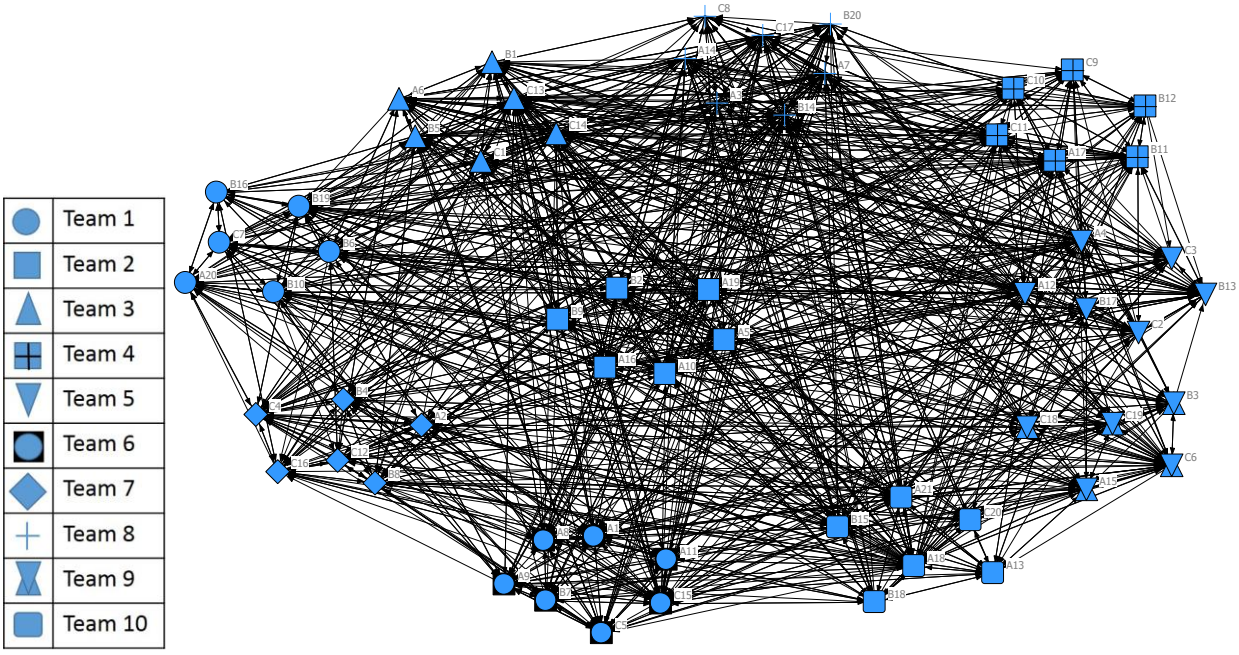

Figure 11. Fall 2015 Round III team collaboration network.

Fall 2015 Committee Network

The density of the committee network experienced a negative change from Round I to Round II, as depicted in Table 5. The within-committee density of collaboration ties among all committees increased from Round II to Round III, and contributed to five of the six committees experiencing an overall increase in the density of collaboration ties. This is indicative of high levels of collaboration, lower levels of collaboration around the midpoint of the semester, and an increase in collaboration as the semester came to a close. Sociograms arranged by committee for each round of data collection are displayed in Figure 12, Figure 13, and Figure 14.

Table 5
Within-Committee Collaboration Network Properties for Fall 2015

	Round I		Round II		Round III		Percent Change		
Committee	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	83	0.92	68	0.76	87	0.97	-21.1	21.6	5.2
2	85	0.77	83	0.76	99	0.90	-1.3	15.6	14.4
3	71	0.79	69	0.77	83	0.92	-2.6	16.3	14.1
4	86	0.96	81	0.90	88	0.98	-6.7	8.2	2.0
5	80	0.89	66	0.73	79	0.89	-21.9	18.0	0.0
6	84	0.93	77	0.86	87	0.97	-8.1	11.3	4.1

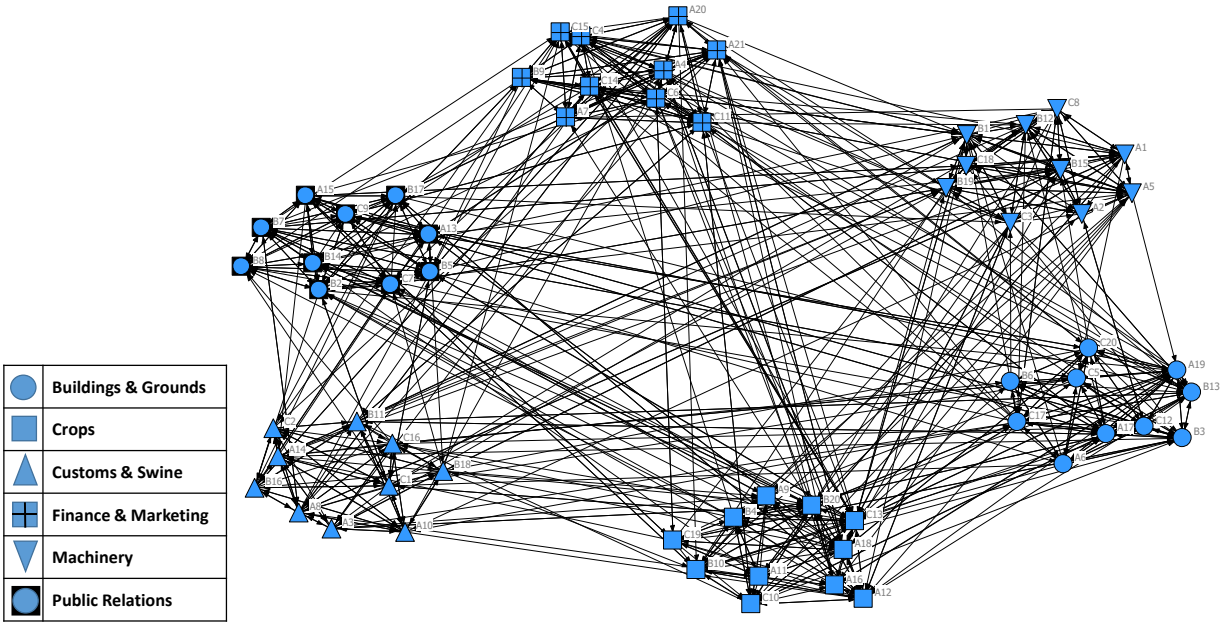

Figure 12. Fall 2015 Round I committee collaboration network.

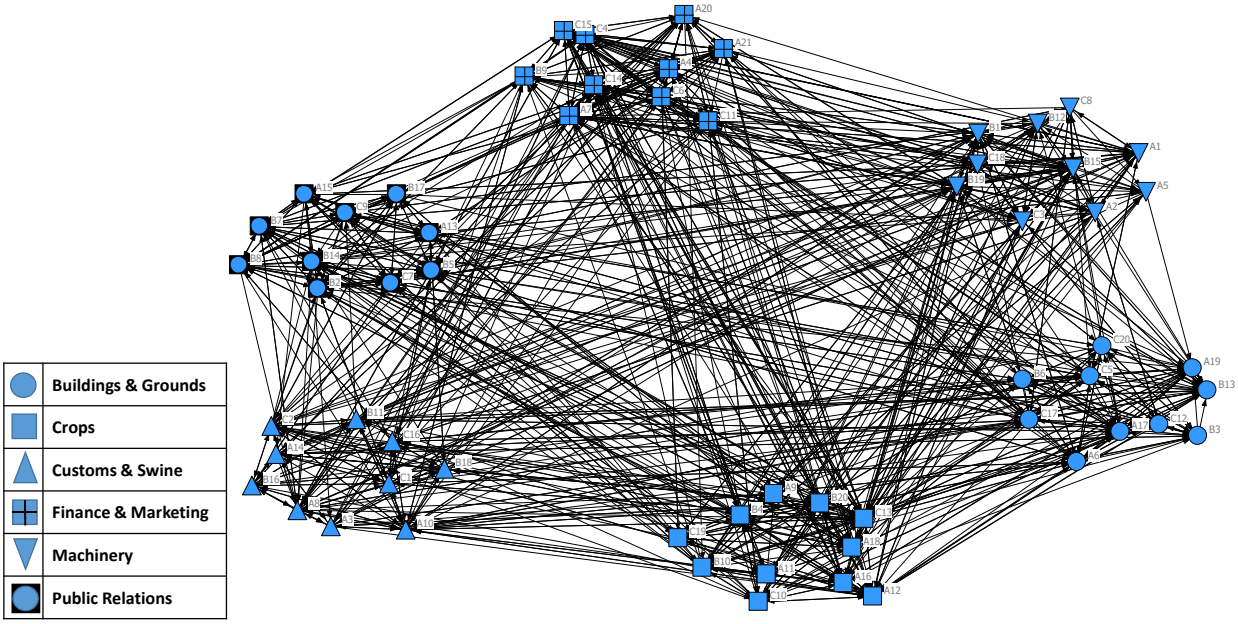

Figure 13. Fall 2015 Round II committee collaboration network.

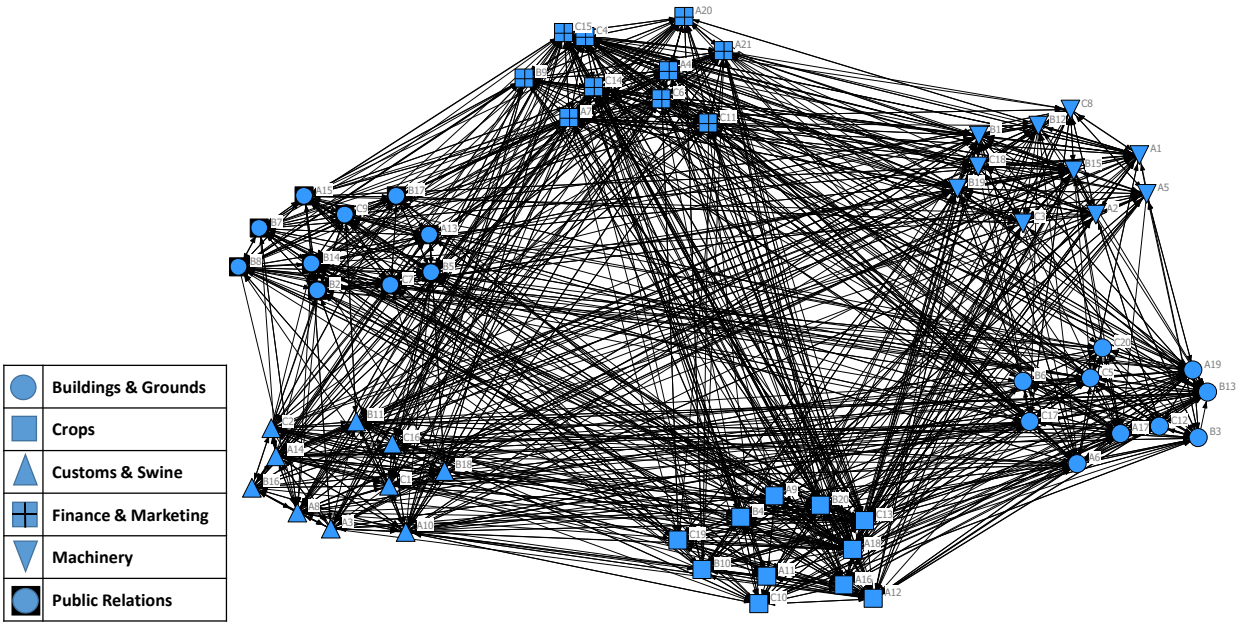

Figure 14. Fall 2015 Round III committee collaboration network.

Fall 2015 Section Network

Within-network characteristics for each section of AgEdS 450 is displayed in Table 6. Within-section collaboration increased across each round of data collection. Section one experienced a 43.8% increase in the overall density of collaboration amongst students.

Table 6

Within-Section Collaboration Network Properties for Fall 2015

	Round I		Round II		Round III		Percent Change		
Section	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	234	0.27	350	0.40	419	0.48	32.5	16.7	43.8
2	215	0.23	339	0.37	419	0.45	37.8	17.8	48.9

Spring 2016 - Whole Network

Eighty-three percent (n = 50) of the students were male, and 17% (n = 10) were female. Section one, which housed teams one through five, contained 50% (n = 30) of the students while

section two, which housed teams six through ten, contained 50% (*n* = 30) of the students. All 60 students (100%) were pursuing a degree in Agricultural Studies with one student pursuing a double major in Agricultural Studies and Speech Communications.

The first objective sought to determine the structure of a collaboration network map from a TBL formatted capstone agriculture course. Sociometric data for Round I (Figure 15), Round II (Figure 16), and Round III (Figure 17) are depicted in graphical form and provide a visualization of the relational structure of a collaboration network. Examination of the sociograms reveal that node C2 (lower right) has the potential to be isolated in Round I, but is more connected to the overall network in Round II and Round III.

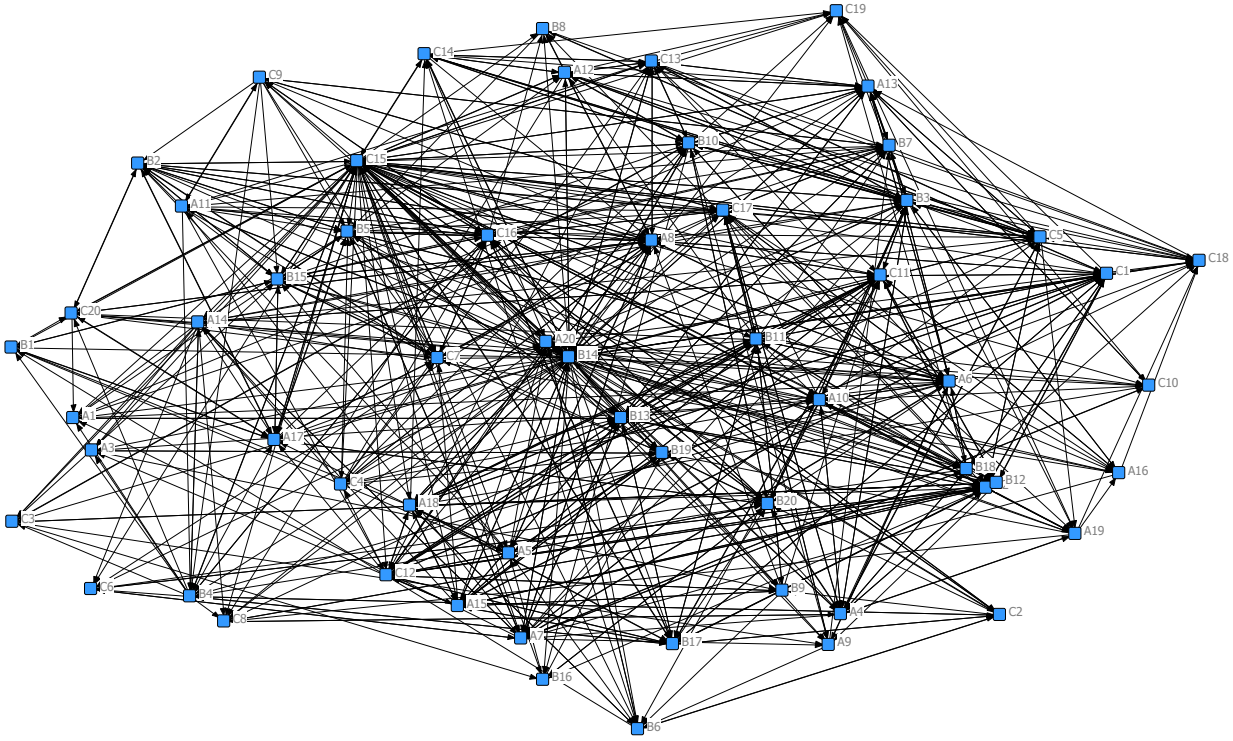

Figure 15. Spring 2016 Round I collaboration network.

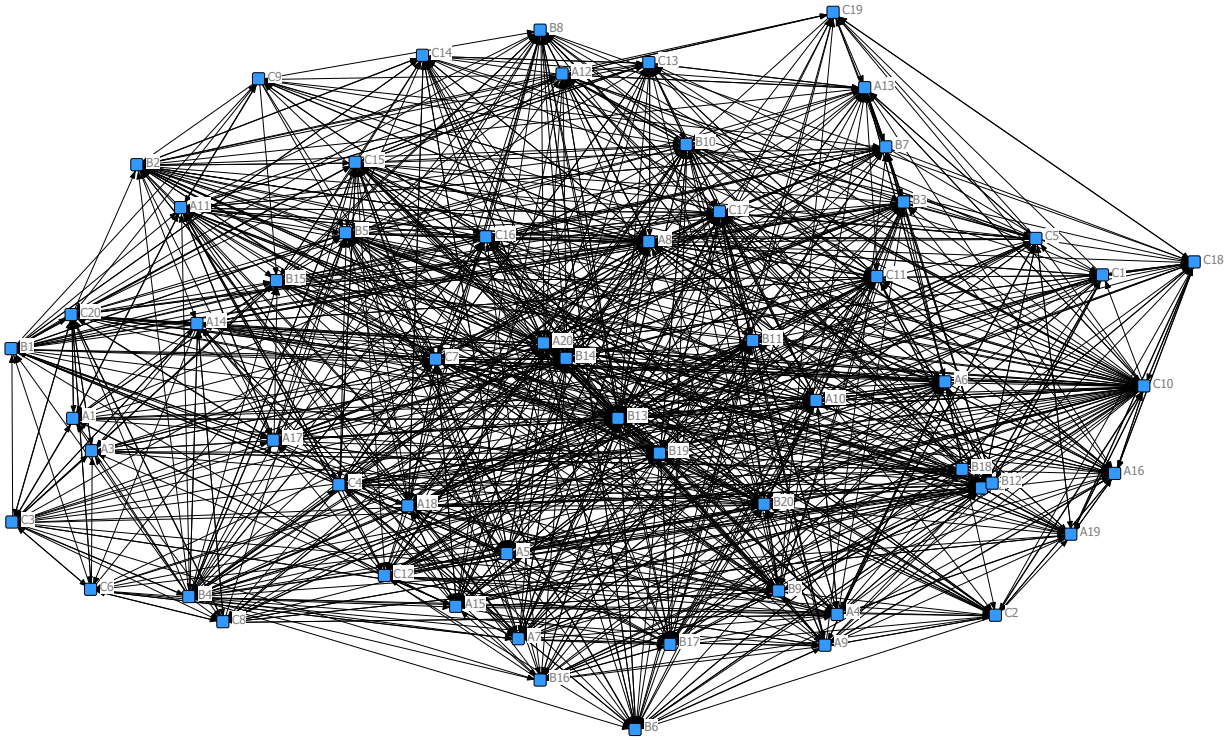

Figure 16. Spring 2016 Round II collaboration network.

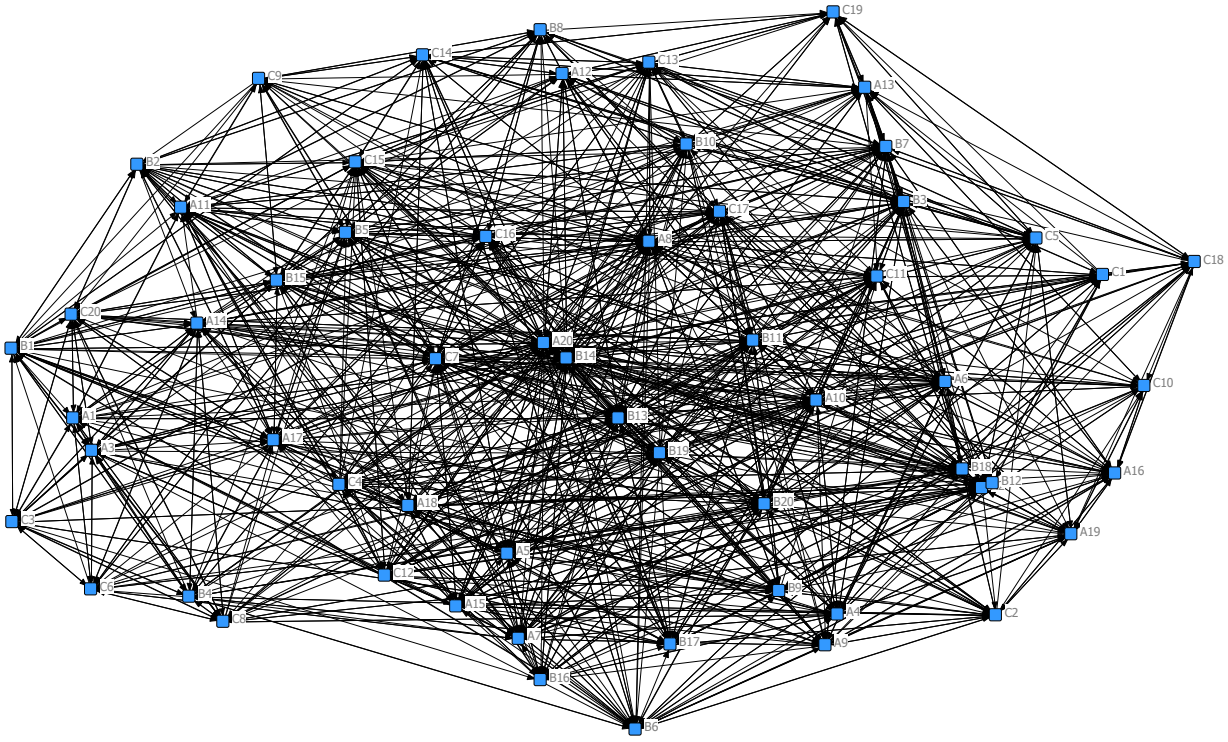

Figure 17. Spring 2016 Round III collaboration network.

The second research objective was addressed by calculating descriptive statistics for the whole network and then calculating the percent change for specific network characteristics. Table 7 provides descriptive statistics for the whole network for each round of data collection. Density of the collaboration within the AgEdS 450 course increased from 0.19 from the initial measure to 0.35 at the end of the semester, an 84.2% increase.

Table 7
Collaboration Network Properties for Spring 2016

Measure	Round I	Round II	Round III
Density	0.19	0.31	0.35
Standard Deviation	0.39	0.46	0.48
Average Degree	11.6	18.2	20.7
Average Geodesic Distance	1.97	1.71	1.65
Standard Deviation	0.61	0.49	0.48
Reciprocity	0.42	0.32	0.58
Transitivity	0.19	0.22	0.17
Blocks	1	1	1
Cutpoints	0	0	0
Diameter	4	3	3
Number of Ties (Actual)	697	1092	1244
Number of Ties (Possible)	3540	3540	3540

Table 8 highlights the percent change for other network characteristics. The diameter of the network decreased from 4 Round I to III in Round II, and remained at 3 for the final measure. Actual ties within the network increased 78.5% from Round I to Round III, meaning more students engaged in collaborative relations with other students.

Table 8
Collaboration Network Change during Spring 2016

	Percent Change		
Measure	Round I to Round II	Round II to Round III	Overall
Density	63.2	12.9	84.2
Average Degree	56.9	13.7	78.4
Average Geodesic Distance	-13.2	-3.5	-16.2
Number of Ties (Actual)	56.7	13.9	78.5

Spring 2016 Team Network

Table 9 displays descriptive statistics for the within-team density for each round of data collection. The percent change of the within-team density for each round is reported as well. Six of the ten teams had exhibited an increase in their network density from Round I to Round II. Two teams experienced a decrease in collaboration and two teams showed no change from Round I to Round II. At the conclusion of the semester all ten teams ended the semester with an increase in the density of their within-team collaboration. Visualization of the network arranged by teams is provided for Round I (Figure 18), Round II (Figure 19), and Round III (Figure 20).

Table 9
Within-Team Collaboration Network Properties for Spring 2016

	Round I		Round II		Round III		Percent Change		
Team	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	17	0.57	21	0.70	26	0.87	18.6	19.5	34.5
2	12	0.60	12	0.60	17	0.85	0.0	29.4	29.4
3	27	0.90	21	0.70	29	0.97	-28.6	27.8	7.2
4	7	0.35	13	0.65	16	0.80	46.2	18.8	56.3
5	10	0.24	17	0.41	23	0.55	41.5	25.5	56.4
6	16	0.53	16	0.53	19	0.63	0.0	15.9	15.9
7	24	0.57	35	0.83	35	0.83	31.3	0.0	31.3
8	11	0.37	10	0.33	20	0.67	-12.1	50.7	44.8
9	5	0.17	14	0.47	17	0.57	63.8	17.5	70.2
10	21	0.70	25	0.83	29	0.97	15.7	14.4	27.8

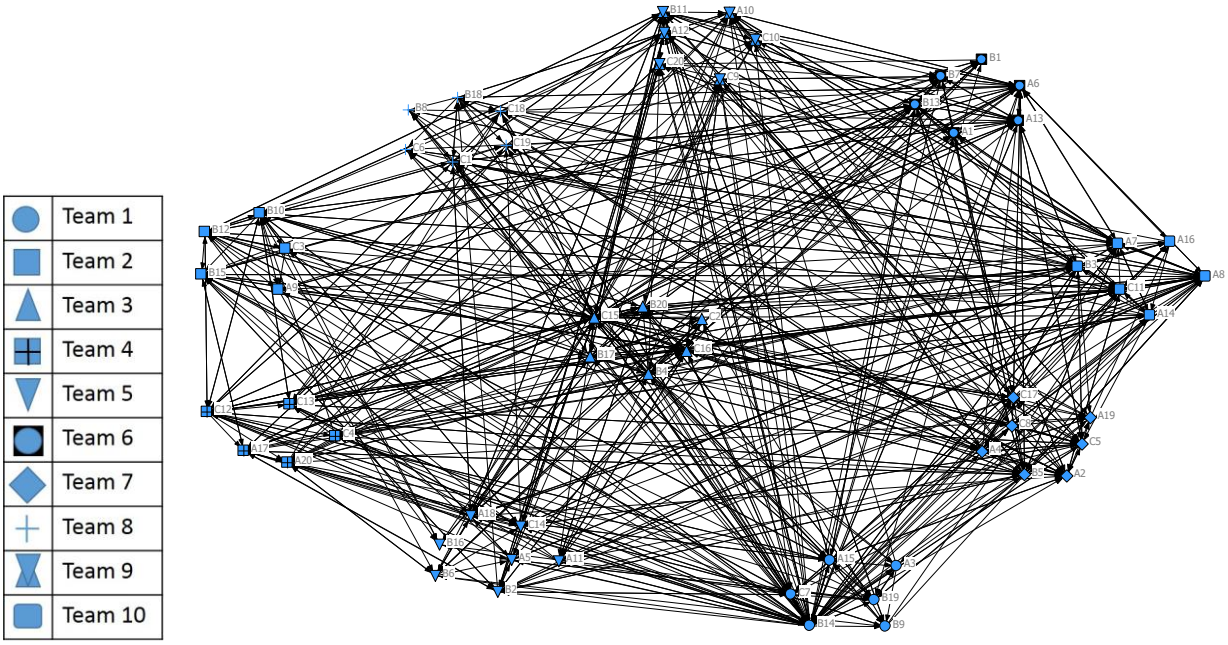

Figure 18. Spring 2016 Round I team collaboration network.

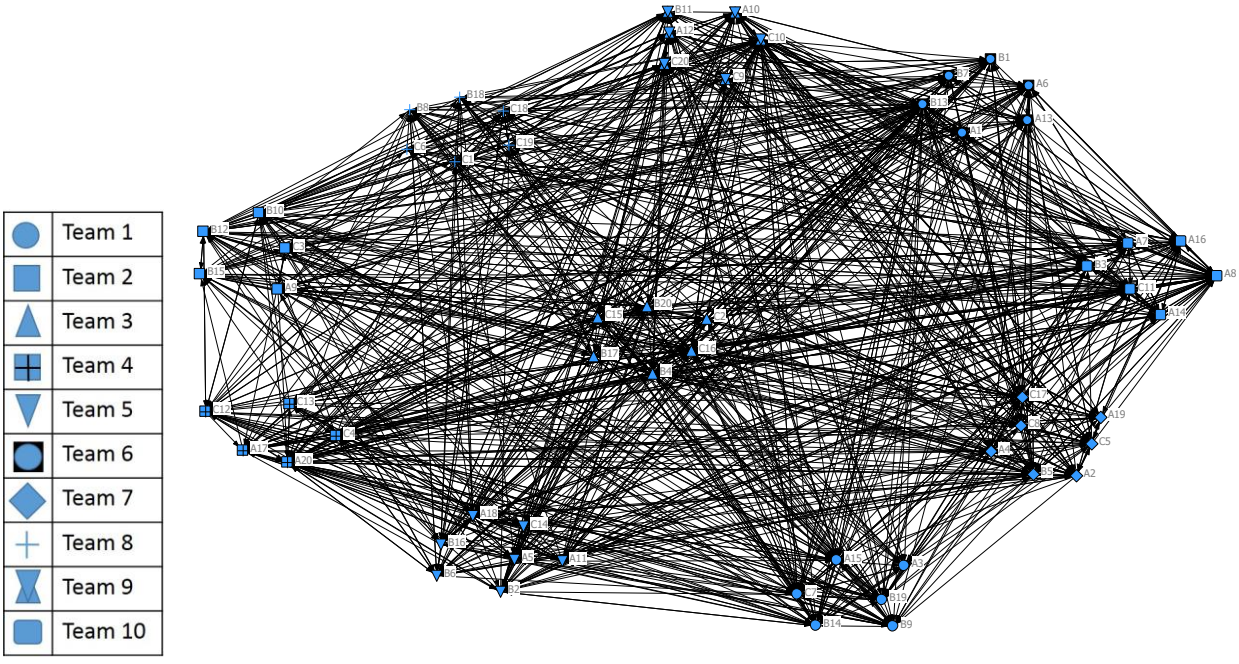

Figure 19. Spring 2016 Round II team collaboration network.

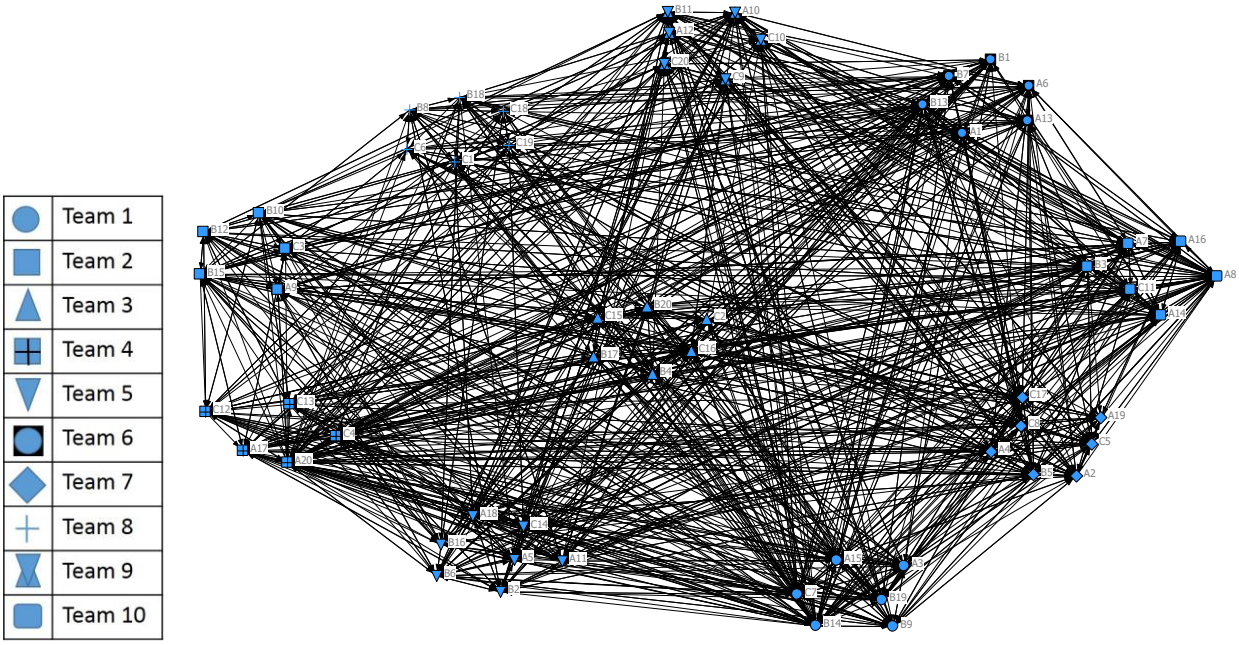

Figure 20. Spring 2016 Round III team collaboration network.

Spring 2016 Committee Network

Two committees experienced a decrease in collaboration from Round I to Round II. Committee one had a 91.5% decrease in collaborative ties while committee 6 experienced a 22.8% decrease in collaboration. All other committees experienced a continual increase in the density of collaborative ties throughout the semester. Committees one and six experienced a decrease in collaboration from Round I to Round II, as depicted in Table 10.

Table 10
Within-Committee Collaboration Network Properties for Spring 2016

	Round I		Round II		Round III		Percent Change		
Committee	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	81	0.90	42	0.47	73	0.81	-91.5	42.0	-11.1
2	14	0.19	41	0.57	52	0.72	66.7	20.8	73.6
3	23	0.27	51	0.57	74	0.82	52.6	30.5	67.1
4	64	0.58	69	0.63	103	0.94	7.9	33.0	38.3
5	33	0.37	45	0.50	80	0.89	26.0	43.8	58.4
6	86	0.97	71	0.79	86	0.96	-22.8	17.7	-1.0

Sociograms arranged by committee for the Spring 2016 semester are displayed for Round I (Figure 21), Round II (Figure 22), and Round III (Figure 23).

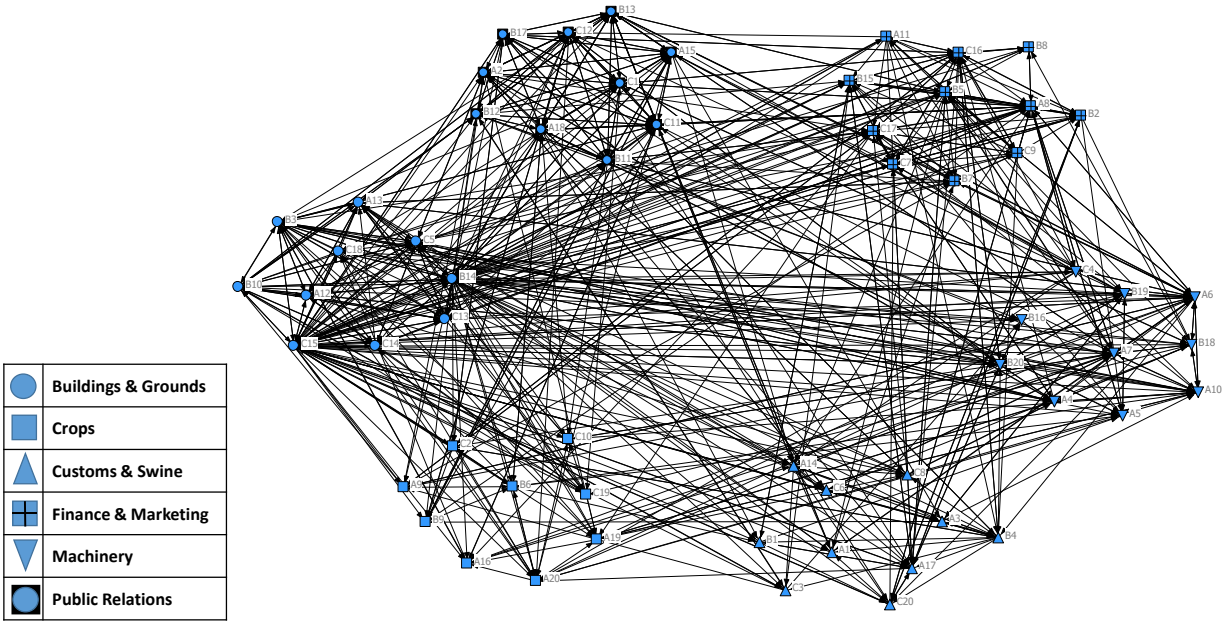

Figure 21. Spring 2016 Round I committee collaboration network.

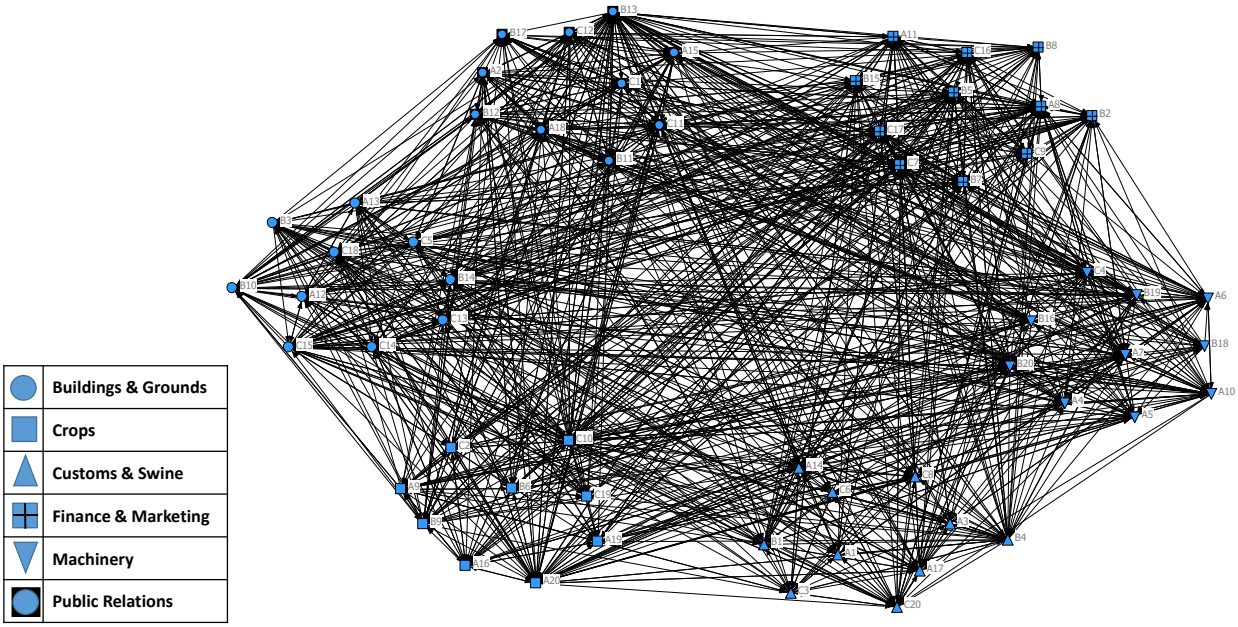

Figure 22. Spring 2016 Round II committee collaboration network.

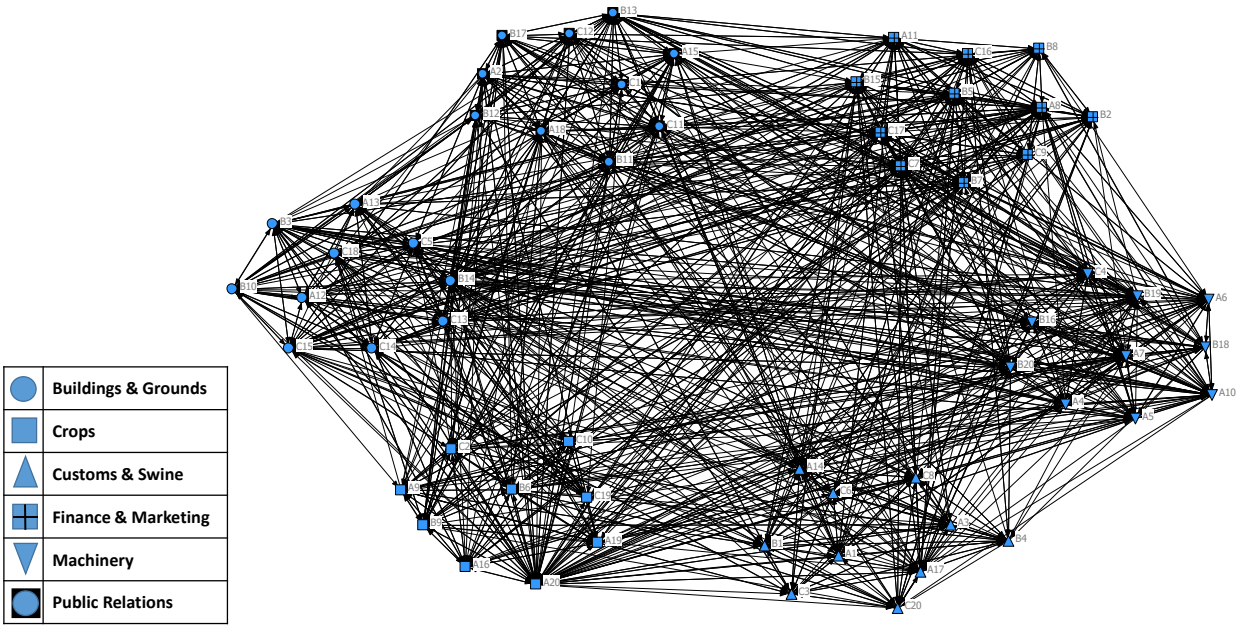

Figure 23. Spring 2016 Round III committee collaboration network.

Spring 2016 Section Network

Each network for within-section collaboration experienced positive growth in collaborative ties throughout the semester, indicating that students within each laboratory section continued to seek out collaborative relations with other students within their respective section. Descriptive statistics are displayed in Table 11.

Table 11
Within-Section Collaboration Network Properties for Spring 2016

	Round I		Round II		Round III		Percent Change		
Section	Ties	Density	Ties	Density	Ties	Density	Round I to Round II	Round II to Round III	Overall
1	235	0.27	321	0.37	420	0.48	27.0	22.9	43.8
2	212	0.24	305	0.35	340	0.39	31.4	10.3	38.5

Conclusions and Discussion

Research objective one sought to determine the structural characteristics of a collaboration network in a TBL formatted capstone course. The network characteristics for the whole network were strikingly similar across semesters. Density for the fall 2015 Round I, Round II, and Round III measures were 0.21, 0.27, and 0.36, respectively. Similarly, the density for Round I, II, and III in the spring 2016 network were 0.19, 0.31, and 0.35, respectively.

Research objective two sought to measure the change in the collaboration networks over the semester. Both semester's networks experienced substantial growth in terms of number of collaborative relationships. Based on the findings of this study, we conclude that the TBL formatted AgEdS 450 course promoted and nurtured collaboration between students. These findings provide validation of this method as Crunkilton et al., (1997) stressed the importance of promoting small group work. TBL seemingly hampers the "hindering element" of large class sizes in a capstone course as well. (Crunkilton et al., p. 9). The global collaboration network (i.e., whole network) sociograms created from the data show dramatic increases in the density of collaboration. Density of the global collaboration network for the fall 2015 semester increased 71.4%, while the spring 2016 density increased 84.2%. The existence of only one block and no cutpoints of the global network across both semesters highlight the stability of the network and no risk of network collapse. In other words, the removal of an individual student would not significantly affect the collaboration network, a finding in congruence with Han et al., (2016).

The AgEdS 450 course is designed utilizing Crunkilton et al.'s (1997) framework for capstone courses which emphasizes teamwork, communication, decision-making, problem-solving, and critical thinking. Based on global network properties, we conclude that teamwork and communication outcomes are being adequately addressed within this specific capstone

course. These findings further support the notion that learning is a social activity (Bandura, 1977; Doolittle & Camp, 1999; Roberts, Murphy, & Edgar, 2010; Vygotsky, 1978).

It is assumed that through the development of these dense, cohesive collaboration networks, students learned from one another and developed friendships that will last beyond their affiliation with the AgEdS 450 course; consistent with a similar assertion from Honeyman (1985). Although performance was not measured in the present study, the growth and development of the collaboration networks align with Bandura's (1977) explanation of environmental, personal factors, and behaviors are bidirectional determinants of learning.

In regards to local networks (i.e., team or committee networks), it can be concluded that teams became more cohesive as the semester progressed. This conclusion aligns with previous research that found permanent teams develop into cohesive units in TBL formatted courses (Michaelsen et al., 2011; Sibley & Ostafichuk, 2014). Though not specifically measured, students' valuation of teams would appear to be high, as they continued to engage in collaborative relationships with other students, and did so at a higher frequency as the semester progressed. The reciprocity within the global network would suggest that students continued to engage in, or seek new collaborative relations with others because they are beneficial to the learning process (Michaelsen et al., 2004; Sibley & Ostafichuk, 2014). It is further assumed that a significant amount of information was distributed throughout the collaboration networks.

Overall, we conclude that the student participants of the TBL formatted AgEdS 450 course were willing and committed to the process of collaboration (Murphrey et al., 2011). This conclusion is evidenced by the substantial growth in collaborative relationships at the local and global levels of the network.

Recommendations and Implications

The findings from this study led to the development of several recommendations for practice and for future research. First, recommendations for practice will be discussed, followed by recommendations for future research. The TBL-formatted AgEdS 450 course provided an environment that supported and nurtured student – student interaction, specifically collaboration. The amount of collaboration continually increased throughout the semester. Instructors who wish to foster collaboration and student self-regulation should consider the adoption of active, student-centered teaching methods that include teams. The researchers recommend special consideration be granted in course design and course revisions in an effort to foster teamwork/collaboration, as well as other 'employability skills' (Han et al., 2016; Knight & Yorke, 2002; Mars, 2015).

Instructors of capstone courses, particularly those who follow the Crunkilton et al. (1997) framework, should participate in professional development activities that focus on the integration of employability skills (Perry et al., 2015). Particular interest should be focused on developing the ability to effectively promote student–student interaction; as this has been shown to increase critical thinking abilities, as well as problem solving and decision making abilities of students (Davis & Jayaratne, 2015; Michaelsen et al., 2008; Sibley & Ostafichuk, 2014; Smith, 1977; Totten, Sills, Digby, & Russ, 1991)

For researchers interested in examining the nature of social network structure in capstone agriculture courses, this study, along with Han et al., (2016), describe a feasible method to collect and analyze sociometric data. This information could be utilized to create deeper insights on specific phenomenon examined within the discipline of agricultural education.

Recommendations for future research are plentiful. First, with the assumption that learning is social in nature and that personal, behavioral, and environmental factors are

reciprocal determinants of one another (Bandura, 1977), we recommend special attention be given to the environmental factor in future research regarding teaching methods. Of particular interest is in determining specific teaching methods or activities that support or hinder student–student collaboration. We recommend this study be replicated and consider additional attributes (variables). The application of SNA with performance data and/or student-perceived values of teams could offer significant insight into the social nature of learning in a multitude of environments. Additionally, pairing a qualitative component with SNA could provide extremely rich data in terms of how students make meaning and construct knowledge in social contexts. Teamwork/collaboration skills have been consistently mentioned as lacking in graduates (Casner-Lotto & Barrington, 2006; Rateau et al., 2015); perhaps the adoption of TBL, or other teaching methods that emphasize teamwork, can offer a solution to this dilemma.

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CHAPTER VII. GENERAL CONCLUSIONS AND RECOMMENDATIONS

Summary

Introduction

The Agricultural Education and Studies (AgEdS) 450 course was developed in order to provide students with practical experience in making farm management decisions (Murray, 1945). Murray (1945) noted that students had little opportunity to gain such practical skills before returning to home-based operations; this ultimately led to the support and establishment of the AgEdS 450 Farm as an applied learning laboratory. This applied setting aligns with the AgEdS departmental mission which states, "The Department of Agricultural Education and Studies' mission is to provide opportunities to learn, discover and apply the knowledge and skills associated with educational processes in agriculture and the life sciences," ("Documents and Forms," 2010). The AgEdS department espoused one fundamental obligation: "…To prepare the learner to become self-directed, and accountable for his/her actions," ("Documents and Forms," 2010). Students must be engaged in the learning process in order to become self-directed.

Engaging students in the learning process is of utmost importance. The adoption of student-centered teaching methods offers unique opportunities to encourage students to become autonomous, self-directed learners. Team-Based Learning (TBL) (Michaelsen, Knight, & Fink, 2004), structures classroom activities so that students develop skills desired by employers in the 21st century in the AgEdS 450 capstone course at Iowa State University.

Purpose and Objectives

The purpose of this dissertation was to explore the effectiveness of TBL through the examination of collaboration networks developed, student engagement, and student perceptions. Specific goals contained within the departmental strategic plan outline a call for the utilization of

the AgEdS 450 course to continually provide a valuable capstone experience for students. With that in mind, specific objectives aligned with chapters IV, V, and VI were:

1) Chapter IV
    a. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development through critical thinking prior to completing the TBL formatted AgEdS 450 course.
    b. Describe student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development through critical thinking after completing the TBL formatted AgEdS 450 course.
    c. Determine if there were changes in student perceptions regarding their attitudes and beliefs about learning, motivation to learn, and professional development through critical thinking after completing the TBL formatted AgEdS 450 course.
    d. Determine students' perceived areas of improvement that would enhance TBL's implementation.
2) Chapter V
    a. Determine the importance of engagement-specific activities within the AgEdS 450 course as reported by the instructional team–instructor, teaching assistant, and the farm operator.
    b. Determine the frequency of student participation in engagement-specific activities within the AgEdS 450 course.
    c. Determine correlations between importance and frequency of engagement-specific activities within the AgEdS 450 course.

3) Chapter VI
    a. Explore collaboration network map structures in a team-based learning formatted course.
    b. Determine if the collaboration network map change over the course of the semester.
    c. Determine if the collaboration networks became more inclusive throughout the semester.

Research Design

This dissertation employed a non-experimental, descriptive research design. The comprehensive examination of the flipped teaching TBL approach required the utilization of a variety of instruments. To address chapter IV's research objectives, the Student Learning Experiences (SLE) instrument (Bickelhaupt & Dorius, 2016) was utilized. The SLE was created at Iowa State University in order to measure change in student's perceptions regarding their attitudes and beliefs about learning, their motivation to learn, and their professional development through critical thinking. Change was measured through a pretest/posttest design. This study was guided by Mezirow's (2000) Transformative Learning Theory.

Student engagement, the focus of chapter V, was examined with the Class-level Survey of Student Engagement (CLASSE) (Ouimet & Smallwood, 2005). The CLASSE was derived from the National Survey of Student Engagement (Kuh, 2004) with the intention of localizing student engagement data (Ouimet & Smallwood, 2005). The CLASSE contains a student version as well as a faculty version. CLASSE Student measures student's involvement in engagement-specific activities within a course. The CLASSE Faculty allows course instructors to report the value they place on each activity contained within the instrument. Resulting data is then

examined in a 2x2 Quadrant Analysis. This concurrent analysis allows congruencies and discrepancies between what students are actually doing and the value instructors place on each activity to emerge. Improving institutional practices, particularly at the classroom level, is the primary purpose of the CLASSE instrument. The theoretical underpinning of this study was student involvement theory (Astin, 1999).

Chapter VI's research objectives were addressed through a social network analysis study. Social network analysis is a set of theoretical and methodological tools that allow researchers to examine relationships and structures within a network (e.g., classroom) environment (Hoppe & Reinelt, 2010). Data were collected through a sociometric questionnaire developed according to Moreno's (1953) design principles. Students identified class peers with whom they had collaborated in AGEDS 450 at three points during the semester; beginning, midpoint, and end. Data were input into adjacency matrices and analyzed through UCINET (Borgatti, Everett, & Johnson, 2013), a statistical and graphical software program for social network analysis. Social constructivism (Vygotsky, 1978) was the guiding theoretical framework in exploring collaboration networks.

Major Findings

Similar across all studies, the majority of respondents were male. This coincides with the typical enrollment in the course as well. Major findings for the dissertation overall will be discussed first, followed by the major findings from each individual study. The major findings for the overall dissertation are:

1) Student perceptions regarding working with teams was significantly higher after completing a semester of TBL.

2) Students were engaged at high levels–both physically and psychologically– throughout the TBL-formatted AgEdS 450 course.
3) Student collaboration networks formed quickly and experienced considerable growth throughout the semester.

Student Learning Experiences (Chapter VI)

Pretest measures indicated that students were situated squarely in the middle ground (neutral) in terms of their perceived value of working in teams. Posttest measures indicated that student perceptions concerning their attitudes and beliefs about learning, motivation to learn, and their professional development through critical thinking increased at the conclusion of the semester. Multiple paired-samples *t*-tests were calculated to compare the means from the pre- and posttest data. For each of the three constructs, statistically significant increases were observed. In other words, at the end of the semester, students valued working in teams; students felt that they were held to high standards, that class time was spent wisely when working with teams, and that their perceived gains in abilities relating to critical thinking were improved. Pearson correlations were computed and a slight negative correlation between GPA and mean difference (posttest *minus* pretest) was found. No differences were found between gender and mean difference or mode of entry into Iowa State and mean difference.

Students also provided qualitative feedback through two open-ended questions. Students offered insightful comments on how to improve the course and general comments regarding their experience. From the qualitative data, students suggested implementing more team activities throughout the semester. Specific suggestions for activities related to marketing application exercises or projects. Other suggestions revolved around communication issues experienced due to the separate laboratory sections utilized in the capstone AgEdS 450 course. Several students

voiced frustration because of this and suggested a larger classroom be built on the farm in order to accommodate the entire class having laboratory sessions at the same time. A few students suggested the organization of the online content or on how the teams and committees should be selected. In AgEdS 450, the students have co-membership on a team as well as a committee. Most students seemed to value that aspect while others suggested having the committee members serve as the team. One student suggested allowing self-selection to teams; a practice currently utilized for committee membership. The student, while acknowledging the benefit of increased communication skills through co-membership, felt that having only committees would be a better format.

For the general comments open-ended question, students provided overwhelmingly positive responses. Students discussed the course structure allowing them to take control of their own learning and holding each other accountable. Students valued getting to be involved in making decisions about classroom policies (e.g., setting grade weights). Others discussed how much they enjoyed the student–student interaction that was fostered within the course.

Furthermore, students discussed the development of abilities relating to effective teamwork and collaboration. Students appreciated the opportunity to learn from their peers throughout the course. Finding new ways to ensure adequate communications was mentioned as good preparation for life after graduation. Students were also cognizant of the diverse backgrounds that their teammates brought to group discussions. Students felt that these diverse perspectives aided their learning and added to the overall experience.

The code with the smallest frequency of responses was *student transformation*. While several of the comments in the previous student responses alluded to a transformation, four responses sagaciously discussed the transformation they experienced as a result of the TBL-

formatted capstone course. One student bluntly exclaimed a negative experience in a previous course that utilized TBL. This student noted appreciation for being involved in the decision making process and realized that working in teams was not the same across courses. Another student recalled a specific application exercise where the class had to select seed for the upcoming planting season. The student mentioned the benefit of navigating this process with students whom had a diverse background. The student continued and connected this particular experience to her personal life and explained how it would help as she transitioned back to the home farm operation.

Class-level Survey of Student Engagement (Chapter V)

The engagement study involved determining the importance the AgEdS 450 instructional team (Professor-in-Charge, Instructor, and Farm Operator) placed upon engagement-specific activities utilized in the course. Across the engagement activity section within the CLASSE instrument, the instructional team rated the integration of ideas from various sources, synthesizing ideas or concepts from other courses, working with other students, providing prompt feedback, presenting information to the class, and coming to class prepared as very important. For cognitive skills, the instructional team valued applying theories or concepts to practical problems as very important; while memorizing facts was only somewhat important. This speaks to the practical nature and applied purpose of the course. For other educational activities, the instructional team felt attendance and interest in the course material were necessary for student success in the course. Review sessions were not valued and were considered not important to student success in the course. All items were considered important or very important to the instructional team within the classroom atmosphere category.

On the CLASSE Student, students reported their participation in the same engagement-specific activities reviewed by the AGEDS 450 instructional team. Within the engagement activities, frequent participation was reported for working with other students, utilizing technology to complete assignments, asking questions during class, and presenting information to the members of the class. For cognitive skills, students reported applying theories or concepts to solve practical problems most frequently; closely followed by making judgments about the value of information, examining how others gathered and interpreted data, and judging the soundness of others conclusions. Students reported utilizing rote memorization techniques less frequently, and subsequently was considered the lowest utilized cognitive skill. For other education practices, students were interested in learning the course material and frequently participated in the completion of intensive writing assignments. Students rarely missed class (low mean is a positive) and did not attend review sessions. Students reported being comfortable discussing items with the instructional team, enjoyed working in teams, and felt the course was somewhat easy.

In conducting the 2x2 Quadrant Analysis to determine differences and similarities between what the instructional team valued and what the students actually did, a majority of items were found to be in alignment. In other words, the faculty highly valued the activities in which the students frequently participated. Likewise, several items the instruction team did not value, students reported lower levels of participation. Less than 30% of all the items were misses; meaning the instructional team valued those activities but the students did not participate in them at high frequencies. Overall, student participation and faculty value concerning engagement-specific activities were aligned closely enough to determine students are engaged at high levels within the AgEdS 450 course.

Overall, TBL is an effective teaching method when employed in the AgEdS 450 course. The organization of activities and emphasis on the application of content knowledge is well suited to carry out the departmental goal of providing a valuable capstone experience for students.

Student Collaboration (Chapter VI)

Exploring student collaboration networks through social network analysis procedures allowed us to visualize collaboration within the capstone course. Resulting network data indicated that students developed collaboration networks quickly. For both semesters the first measure of student collaboration occurred at the end of the first week of class. In the fall 2015 initial measure, 753 collaboration ties were present out of 3660 possible. At the midpoint and end of semester collection, actual ties were 992 and 1306, respectively. Overall, team and committee collaboration networks increased from the initial to the end-of-semester collection. The spring 2016 network experienced similar development and growth throughout the semester. For the whole network, initial collaborative ties present were 697 out of 3540. Actual ties present increased to 1092 at the midpoint and to 1244 at the end-of-semester measure. For both semesters, the whole network experienced considerable growth to become a cohesive unit. Students continued to engage in collaborative relationships with their classmates throughout the semester.

Conclusions

Viewed individually, the results from each study led to a number of conclusions. Likewise, when observed in their entirety, additional conclusions emerged. Conclusions from each study will be presented first, followed by the overall conclusions.

Student Learning Experiences (Chapter IV)

1) TBL has the ability to widen a student's frame of reference. The transference of authority is likely the disorienting dilemma explicated by Mezirow (2000).
2) Students develop an improved perception concerning the value of teamwork through the implementation of TBL.
3) Students' perceptual gains in their abilities related to critical thinking are increased through exposure to TBL.
4) TBL has the potential to serve as a pedagogical approach in order to create meaningful and engaging learning environments.

Class-level Survey of Student Engagement (Chapter V)

1) The CLASSE instrument is a useful tool for examining classroom practice in assessing student engagement. It can offer valuable insight for curricular revisions.
2) TBL promotes high levels of physical and psychological engagement.
3) TBL encourages higher order thinking skills.

Student Collaboration (Chapter VI)

1) TBL promotes high levels of collaboration among students.
2) Collaborative relationships are continually utilized within and between teams, sections, and committees.
3) The visualization of the collaboration network supports the notion that learning is inherently social.

General Conclusions and Discussion

1) TBL is an effective, student-centered teaching method that fosters the development of skills needed by graduates.

Teamwork is an essential trait for post-secondary graduates entering the workforce (Espey, 2010; Lamm, Carter, & Melendez, 2014; Lamm, Carter, Stedman, & Lamm, 2014). TBL, a student-centered teaching method (Michaelsen, Knight, & Fink, 2004), promoted teamwork/collaboration and the utilization of higher order thinking skills within the AgEdS 450 course. Students applied theories and concepts with alongside their peers in order to solve complex problems and make decisions. Working collaboratively, communicating effectively, and possessing critical thinking and problem solving abilities are skills most desired by employers of college graduates (Casner-Lotto & Barrington; Rateau, Kaufman, & Cletzer, 2015). TBL is an effective method to ensure students are prepared for employment in the 21st century workforce.

2) TBL engages students in applying content and involves them in the learning process. Students take control of their learning and hold themselves–and their fellow teammates–to high standards.

TBL engages students in the learning process so that they become active participants within the learning environment (Michaelsen et al., 2004; Sibley & Ostafichuk, 2014). Through the TBL structure, students hold themselves and their peers accountable. The use of small groups is beneficial in promoting cognitive elaboration, promoting social development, as well as creating conditions for frequent feedback (Cooper & Robinson, 2000; Michaelsen et al., 2004; Michaelsen, Sweet, & Parmalee, 2011). The TBL structure also emphasizes time on task–an indicator of good practice in undergraduate education (Chickering & Gamson, 1987)–through an emphasis on applying content to solve complex, real-world problems (Sibley & Ostafichuk, 2014).

3) TBL principles and the capstone course framework provide a valuable experience for students enrolled in AgEdS 450.

Contemplative of the results of each of the three studies in this dissertation, the integrated framework of capstone course components (Crunkilton, Cepica, & Fluker, 1997) and the TBL sequence of activities (Michaelsen et al., 2004) offers students a valuable educational experience. Students enter the AgEdS 450 course with fragmented disciplinary knowledge, and through the course structure they are able integrate and synthesize the subject matter while developing necessary skills for long-term success. Students develop a more positive perception for the value of teamwork over the course of a semester, similar to findings from Espey (2010). Students are engaged in the learning environment, both physically and psychologically (Astin, 1999), which is of utmost importance in student learning and development (Hu & Kuh, 2002).

Recommendations

Based upon the findings and conclusions of this study, several recommendations for action and for future research were developed.

Recommendations for Action

1) Continued implementation and refinement of TBL in the AgEdS 450 course. Continual assessment of the teaching methods effectiveness should be conducted. Results should be utilized from the assessments for course revisions as deemed necessary.
2) The Center for Excellence in Learning and Teaching, or similar programs at other institutions, should develop a localized TBL certification to ensure its principles are implemented in a consistent manner within the institution. This could be achieved through targeted professional development workshops and serve as a token of an individual's commitment to the teaching and learning process.

3) TBL should be tested in other capstone courses across colleges of agriculture, or other courses that emphasize the development of teamwork, collaboration, and higher order thinking skills.
4) Professional development opportunities should be sought for all faculty members implementing the TBL method. This would aid in the continual refinement of the teaching practice to ensure its core principles are implemented correctly.
5) Faculty members across the agricultural education discipline should strive for meaningful and engaging learning environments through the adoption of student-centered teaching approaches. TBL is a promising practice to ensure students become active within the learning environment.
6) University administration should place more emphasis on teaching evaluations for faculty with teaching responsibility in the promotion and tenure process. This would incentivize the proper attention that should be directed to the teaching and learning process for all students within an institution.

Recommendations for Research

1) TBL's effectiveness in other courses within colleges of agriculture should be examined by faculty members committed to learning and implementing the methods core principles.
2) Students' critical thinking abilities before and after a TBL-formatted course should be examined, similar to Perry, Paulsen, and Retallick's (2015) study.
3) Aligned with Andreasen and Trede's (2000) study, a follow-up study on course alumni who experienced the TBL-formatted AgEdS 450 course should be conducted in order to assess the perceived long-term benefits of the TBL method.

4) A qualitative examination of student perceptions should be conducted to gather a more complete picture of student experiences in the TBL course.
5) As an extension of the development of cohesive collaboration networks, increased network measurements should be implemented to identify which components are most beneficial in promoting teamwork and collaboration.
6) Examination of effects that various student characteristics may have on student performance, satisfaction, engagement, and collaboration.
7) An experimental study of TBL and a control to measure differences in student performance.

TBL is one possible solution to the consistent perpetuation of teacher-centered instructional approaches. Perhaps TBL is a movement that will be established in the profession. The incorporation of TBL in AgEdS 450 has been a positive experience for students and for this researcher: It has certainly solidified my commitment to the teaching and learning process and enlightened me to the amazing things students are capable of. It is conceivable that educators within agricultural education–at all levels–may soon stop offering excuses for passive classrooms, and begin working collaboratively to overcome obstacles on the journey to providing meaningful and engaged learning environments to all those who enter.

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APPENDIX A.

INSTITUTIONAL REVIEW BOARD APPROVAL FOR SLE

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 8/20/2015

To:

From: Office for Responsible Research

Title: Team-Based Learning Student Learning Experience

IRB ID: 15-391

Approval Date:	8/20/2015	**Date for Continuing Review:**	8/19/2017
Submission Type:	New	**Review Type:**	Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX B.

INSTITUTIONAL REVIEW BOARD APPROVAL FOR CLASSE

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 12/4/2015

To:

From: Office for Responsible Research

Title: Utilizing CLASSE to Measure Student Engagement in a TBL Formatted Course

IRB ID: 15-390

Approval Date:	12/3/2015	**Date for Continuing Review:**	10/6/2017
Submission Type:	Modification	**Review Type:**	Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
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- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

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Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX C.

INSTITUTIONAL REVIEW BOARD APPROVAL FOR SNA

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 9/1/2015

To:

From: Office for Responsible Research

Title: Social Network Analysis Mapping in an Undergraduate Capstone Course

IRB ID: 15-259

Approval Date:	8/27/2015	**Date for Continuing Review:**	8/26/2017
Submission Type:	New	**Review Type:**	Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study,** when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses,** unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

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APPENDIX D.

PERMISSIONS TO REPRINT

Team-Based Learning- Stylus Publishing Permission

Tammy D. Radford <tammy@styluspub.com> Tue, Apr 8, 2014 at 7:31 AM
Reply-To: "Tammy D. Radford" <tammy@styluspub.com>
To: OP McCubbins <opmcc@iastate.edu>

Dear OP,

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Best Regards,

Tammy Radford

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From: OP McCubbins [mailto:opmcc@iastate.edu]
Sent: Monday, April 07, 2014 3:29 PM
To: tammy@styluspub.com
Subject: Permission to Reprint

Hello Tammy,

I received your email from customer service. I am currently working on a research proposal for my dissertation and was curious on how I could get permission to include figures from the Team-Based Learning books by Larry Michaelsen. Any help is greatly appreciated.

OP McCubbins

Graduate Assistant

Collegiate FFA Graduate Advisor

College of Agriculture & Life Sciences

Department of Agricultural Education & Studies

223A Curtiss Hall

Ames, IA 50011

859-444-3966

What Matters to Student Success- George Kuh Permission

Permission to Use

7 messages

OP McCubbins <opmcc@iastate.edu> Fri, Apr 22, 2016 at 3:52 PM
To: gdkuh@illinois.edu

Good afternoon Dr. Kuh,

I am a doctoral candidate in Agricultural Education at Iowa State University and am currently working on my dissertation. My dissertation is covering the effectiveness of Team-Based Learning in an undergraduate capstone course. I am measuring this based on student learning experiences, student engagement (as measured by the CLASSE instrument), and the development and growth of collaboration networks (social networks within the course). To conceptualize student engagement and its importance in relation to student outcomes, I am interested in utilizing the What Matters to Student Success figure. I have seen this figure in a NCEP report as well as a ASHE report. I am reaching out to you for permission to use or information for where I should request such permission. The figure would be used in my dissertation and potentially in a journal article resulting from my dissertation. Two copies of my dissertation will be bound (departmental archiving and one for my personal library) and a copy will be stored on Iowa State University's Digital Repository. Thanks in advance for your time and assistance.

--
OP McCubbins
Instructor- AGEDS 450
Agricultural Education & Studies
College of Agriculture & Life Sciences
Iowa State University
opmcc@iastate.edu
859-444-3966
Learner/Self-Assurance/Woo/Communication/Includer

Follow the Ag 450 Farm on Social Media!

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Kuh, George D. <kuh@indiana.edu> Fri, Apr 22, 2016 at 4:53 PM
To: OP McCubbins <opmcc@iastate.edu>
Cc: "gdkuh@illinois.edu" <gdkuh@illinois.edu>, "Kinzie, Jillian L." <jikinzie@indiana.edu>

Dear OP McCubbins:

You have my permission to use the WMSS figure from our NPEC report for the purposes described below, provided you include the complete citation for the figure; the ASHE report is preferred

Good luck with your research. Cheers

Sent from GK's iPhone

[Quoted text hidden]

OP McCubbins <opmcc@iastate.edu> Fri, Apr 22, 2016 at 5:10 PM
To: "Kuh, George D." <kuh@indiana.edu>

APPENDIX E.

INSTRUMENTS

Student Learning Experience Pretest

Student Learning Experience PRE-TEST

Thank you for participation in this survey. Please mark the answer that most closely matches your experience as a student learner. Remember there are no right or wrong answers.

The following questions are about your past coursework EXPERIENCE working in a group and as an individual.

	N/A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I work well in a classroom environment where I have been required to work in a group.	0	1	2	3	4	5
2. Group work motivates me to work harder in my coursework.	0	1	2	3	4	5
3. Group members in a classroom environment encourage each other to give their best efforts.	0	1	2	3	4	5
4. Working in a group on classroom activities motivates me to work more collaboratively.	0	1	2	3	4	5
5. Being in a group helps me become better at problem solving.	0	1	2	3	4	5
6. Classroom group work promotes high standards of performance.	0	1	2	3	4	5
7. Being part of a group helps me challenge previous ideas and improve my learning.	0	1	2	3	4	5
8. Being part of a group discussion helps me to improve my ability to think through a problem.	0	1	2	3	4	5
9. Solving problems in a group is an effective way to apply what I learn.	0	1	2	3	4	5
10. When a theory, interpretation, or conclusion has been presented in other courses or in previous readings, I try to decide if there is good supporting evidence.	0	1	2	3	4	5
11. I treat course material as a starting point and try to develop my own ideas about it.	0	1	2	3	4	5
12. I try to play around with ideas of my own related to what I have learned in a class.	0	1	2	3	4	5
13. Whenever I read or hear a statement or conclusion in my courses, I think about possible alternatives.	0	1	2	3	4	5
14. I am typically given the appropriate resources to do well in my coursework.	0	1	2	3	4	5

Student Learning Experience PRE-TEST

The following questions are about your BELIEFS about group and individual learning.

	N/A	Not at All True of Me		Sometimes	Neutral	Mostly	Very True of Me
15. The ability to collaborate with my peers is necessary for me to be a successful student.	0	1		2	3	4	5
16. I believe solving problems in a group leads to better decisions than solving problems on my own.	0	1		2	3	4	5
17. The ability to work with my peers is a valuable learning tool.	0	1		2	3	4	5
18. Collaborating with my peers helps me to be a better student.	0	1		2	3	4	5
19. I believe solving problems in a group is an effective way for me to learn.	0	1		2	3	4	5
20. Working in a group is a productive way for me to spend class time.	0	1		2	3	4	5
21. I believe that being part of a group improves my grades.	0	1		2	3	4	5
22. When I study in appropriate ways, I am able to learn the material in my courses.	0	1		2	3	4	5
23. If I don't understand the course material, it is because I don't try hard enough.	0	1		2	3	4	5
24. It is my own fault if I don't learn the course material for a given class.	0	1		2	3	4	5
25. If I try hard enough, then I understand the course material.	0	1		2	3	4	5
26. I am confident I understand the basic concepts taught in my past courses.	0	1		2	3	4	5
27. I am certain I understand the most difficult material presented in the readings for my past courses.	0	1		2	3	4	5
28. I am confident I do an excellent job on assignments and tests in my past courses.	0	1		2	3	4	5
29. I am certain I have grasped the skills that have been taught in my past courses.	0	1		2	3	4	5
30. I expect that I will receive an excellent grade in this course.	0	1		2	3	4	5
31. I believe I can do more than I have in my past courses to receive the grade I want in this course.	0	1		2	3	4	5
	0	1		2	3	4	5

Student Learning Experience PRE-TEST

	N/A	Not at All True of Me	Sometimes	Neutral	Mostly	Very True of Me
32. I believe I can perform independently with the knowledge I will learn in this course.	0	1	2	3	4	5
33. I am confident I can apply the knowledge I will learn in this course in future tasks.	0	1	2	3	4	5
34. I make sure that I keep up with weekly readings and assignments for my courses.	0	1	2	3	4	5
35. I am satisfied with the grades that I have earned in my other courses.	0	1	2	3	4	5
36. I have experienced a teaching technique called Team-Based Learning in my other courses.	0	1	2	3	4	5

Please answer the following questions. Your answers will be kept confidential.

Student Learning Experiences Posttest

Student Learning Experience Survey

Thank you for participation in this survey. Please mark the answer that most closely matches your experience in this course. Remember there are no right or wrong answers.

The following questions are about your EXPERIENCE working in a team and as an individual in this course.

	N/A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. During this course, my team and I have worked well together.	0	1	2	3	4	5
2. I have found that my team has motivated me to work harder in this course.	0	1	2	3	4	5
3. The members of my team encouraged each other to give their best efforts.	0	1	2	3	4	5
4. I have found that my team has motivated me to work more collaboratively in this course.	0	1	2	3	4	5
5. I have found that being on a team has helped me become better at problem solving.	0	1	2	3	4	5
6. The members of my team maintained high standards of performance.	0	1	2	3	4	5
7. I have found that being part of a team has helped to challenge previous ideas and improve my learning.	0	1	2	3	4	5
8. Being part of a team discussion has improved my ability to think through a problem.	0	1	2	3	4	5
9. Solving problems in a group was an effective way to apply what I have learned.	0	1	2	3	4	5
10. When a theory, interpretation, or conclusion was presented in class or in the readings, I tried to decide if there was good supporting evidence.	0	1	2	3	4	5
11. I treated the course material as a starting point and tried to develop my own ideas about it.	0	1	2	3	4	5
12. I tried to play around with ideas of my own related to what I was learning in this course.	0	1	2	3	4	5
13. Whenever I read or heard a statement or conclusion in this course, I thought about possible alternatives.	0	1	2	3	4	5
14. I was given the appropriate resources to do well in this course.	0	1	2	3	4	5

Student Learning Experience Survey

The following questions are about your BELIEFS about team and individual learning in this course.

	N/A	Not at All True of Me	Sometimes	Neutral	Mostly	Very True of Me
15. The ability to collaborate with my peers was necessary for me to be a successful student in this class.	0	1	2	3	4	5
16. I believe solving problems in groups has led to better decisions than solving problems on my own.	0	1	2	3	4	5
17. The ability to work with my peers in this class was a valuable experience for me.	0	1	2	3	4	5
18. Collaborating with my peers helped me to be a better student.	0	1	2	3	4	5
19. I believe solving problems in a group was an effective way for me to learn.	0	1	2	3	4	5
20. Working in teams in class has been a productive way for me to spend class time.	0	1	2	3	4	5
21. I believe that being part of a team has improved my grades in this course.	0	1	2	3	4	5
22. When I studied in appropriate ways, I was able to learn the material in this course.	0	1	2	3	4	5
23. If I didn't understand the course material, it was because I didn't try hard enough.	0	1	2	3	4	5
24. It was my own fault if I didn't learn the material in this course.	0	1	2	3	4	5
25. If I tried hard enough, then I understood the course material.	0	1	2	3	4	5
26. I am confident I understood the basic concepts taught in this course.	0	1	2	3	4	5
27. I am certain I understood the most difficult material presented in the readings for this course.	0	1	2	3	4	5
28. I am confident I did an excellent job on the assignments and tests in this course.	0	1	2	3	4	5
29. I am certain I grasped the skills that were taught in this course.	0	1	2	3	4	5
30. I expect that I will receive an excellent grade in this course.	0	1	2	3	4	5
31. I believe I could have done more to receive the grade I wanted in this course.	0	1	2	3	4	5

Student Learning Experience Survey

	N/A	Not at All True of Me	Sometimes	Neutral	Mostly	Very True of Me
32. I believe I can perform independently with the knowledge I have gained in this course.	0	1	2	3	4	5
33. I am confident I can apply the knowledge I have learned in this course in future tasks.	0	1	2	3	4	5
34. I made sure I kept up with the weekly readings and assignments for this course.	0	1	2	3	4	5
35. I am satisfied with the grade that I believe I have earned in this course.	0	1	2	3	4	5

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36. What if anything would have enhanced your Team-Based Learning experience during this course?

37. Please provide any addition information you would like to share regarding your experience as an individual learner or working with your team in this course.

Class-Level Survey of Student Engagement: Student Version

IOWA STATE UNIVERSITY

CLASSE STUDENT
Classroom Survey of Student Engagement*

This survey includes items that ask about your participation in AgEdS 450 and about educational practices that occur in this class. Your honest and straightforward responses to these questions will help us identify targets for improvements and enable us to provide an even higher quality academic experience.

PART I: ENGAGEMENT ACTIVITIES

So far this semester, how often have you done each of the following in your AgEdS 450 class?	Never ▼	1 or 2 times ▼	3 to 5 times ▼	More than 5 times ▼
1. Asked questions during your AgEdS 450 class	☐	☐	☐	☐
2. Contributed to a class discussion that occurred during AgEdS 450 class	☐	☐	☐	☐
3. Prepared two or more drafts of a paper or assignment in your AgEdS 450 class before turning it in	☐	☐	☐	☐
4. Worked on a paper or a project in your AgEdS 450 class that required integrating ideas or information from various sources	☐	☐	☐	☐
5. Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments in your AgEdS 450 class	☐	☐	☐	☐
6. Came to your AgEdS 450 class without having completed readings or assignments	☐	☐	☐	☐
7. Worked with other students on projects **during** your AgEdS 450 **class**	☐	☐	☐	☐
8. Worked with classmates **outside of** your AgEdS 450 **class** to prepare class assignments	☐	☐	☐	☐
9. Put together ideas or concepts from different courses when completing assignments or during class discussions in your AgEdS 450 class	☐	☐	☐	☐
10. Tutored or taught other students in your AgEdS 450 class	☐	☐	☐	☐
11. Used an electronic medium (list-serv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment in your AgEdS 450 class	☐	☐	☐	☐
12. Used email to communicate with the instructor of your AgEdS 450 class	☐	☐	☐	☐
13. Discussed grades or assignments with the instructor of your AgEdS 450 class	☐	☐	☐	☐
14. Discussed ideas from your AgEdS 450 with others outside of class (students, family members, coworkers, etc.)	☐	☐	☐	☐
15. Made a class presentation in your AgEdS 450 class ☐ Never ☐ Once ☐ 2 times ☐ More than 2 times				

16. Participated in a community-based project (e.g., service learning) as part of your AgEdS 450 class
☐ Never ☐ Once ☐ 2 times ☐ More than 2 times

17. Discussed ideas from your readings or classes with your AgEdS 450 instructor outside of class
☐ Never ☐ Once ☐ 2 times ☐ More than 2 times

18. Received prompt written or oral feedback on your academic performance from your AgEdS 450 instructor
☐ Never/Rarely ☐ Sometimes ☐ Often ☐ Very Often

19. Worked harder than you thought you could to meet your AgEdS 450 instructor's standards or expectations
☐ Never/Rarely ☐ Sometimes ☐ Often ☐ Very Often

PART II: COGNITIVE SKILLS

So far this semester, how much of your coursework in your AgEdS 450 class emphasized the following mental activities?	Very Little ▼	Some ▼	Quite a Bit ▼	Very Much ▼
20. **Memorizing** facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	☐	☐	☐	☐
21. **Analyzing** the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	☐	☐	☐	☐
22. **Synthesizing** and organizing ideas, information, or experiences into new, more complex interpretations and relationships	☐	☐	☐	☐
23. **Making Judgments** about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	☐	☐	☐	☐
24. **Applying** theories or concepts to practical problems or in new situations	☐	☐	☐	☐

PART III: OTHER EDUCATIONAL PRACTICES

So far this semester

25. How often in your AgEdS 450 class have you been required to prepare written papers or reports of more than 5 pages in length?
☐ Never ☐ Once ☐ 2 times ☐ 3 or more times

26. To what extent do the examinations in your AgEdS 450 class challenge you to do your best work?
☐ Very little ☐ Some ☐ Quite a bit ☐ Very much

27. In a **typical week** in your AgEdS 450 class, how many homework assignments take you more than one hour each to complete?
☐ None ☐ 1 or 2 ☐ 3 or 4 ☐ 5 or more

28. In a **typical week**, how often do you spend more than 3 hours preparing for your AgEdS 450 class (studying, reading, doing homework or lab work, analyzing data, rehearsing, and other academic matters)?
☐ Never/Rarely ☐ Sometimes ☐ Often ☐ Very Often

29. How many times have you been absent so far this semester in your AgEdS 450 class?
☐ None ☐ 1 - 2 absences ☐ 3 – 4 absences ☐ 5 or more absences

30. How frequently do you take notes in your AgEdS 450 class?
☐ Never/Rarely ☐ Sometimes ☐ Often ☐ Very Often

31. How often do you review your notes prior to the next scheduled meeting in your AgEdS 450 class?
☐ Never/Rarely ☐ Sometimes ☐ Often ☐ Very Often

32. How often have you participated in a study partnership with a classmate in your AgEdS 450 class to prepare for a quiz or a test?
☐ Never ☐ Once ☐ 2 times ☐ 3 or more times

33. How often have you attended a review session or help session to enhance your understanding of the content of your AgEdS 450 class?
☐ Never ☐ Once ☐ 2 times ☐ 3 or more times

34. How interested are you in learning the AgEdS 450 course material?
☐ Very uninterested ☐ Uninterested ☐ Interested ☐ Very Interested

PART IV: CLASS ATMOSPHERE

So far this semester, what are your general impressions of the AgEdS 450 class atmosphere?

35. How comfortable are you talking with the instructor of your AgEdS 450 class?
☐ Uncomfortable ☐ Somewhat Comfortable ☐ Comfortable ☐ Very Comfortable

36. How much do you enjoy group work with your classmates in your AgEdS 450 class?
☐ Very Little ☐ Some ☐ Quite a Bit ☐ Very Much

37. How difficult is the course material in your AgEdS 450 class?
☐ Easy ☐ Somewhat Difficult ☐ Difficult ☐ Very Difficult

38. How easy is it to follow the lectures in your AgEdS 450 class?
☐ Difficult ☐ Somewhat Easy ☐ Easy ☐ Very Easy

PART V: ADDITIONAL INFORMATION

39. Additional comments:

PART VI: DEMOGRAPHICS

40. How many credit hours are you enrolled in this semester?
☐ 1–6 credit hours ☐ 7–11 credit hours ☐ 12-15 credit hours ☐ >15 credit hours

41. What is your classification?
☐ Freshman (<30 hrs) ☐ Sophomore (30-59 hrs) ☐ Junior (60- 89 hrs) ☐ Senior (90+ hrs)

41. What is your academic major?

Please enter your full name here:_____

Please select the course you are enrolled in:

We ask you to identify yourself by name in order to permit us to relate your responses to the particular educational experience you've had at the Iowa State University. Please know that your individual responses will remain confidential. No individual responses will ever be identified in any report, shared with your faculty instructor, or in any other way made available. As a student-centered university, we know we will make the best decisions to improve the educational experience when those decisions are informed by student feedback. Thank you for helping us attain this goal.

Thank you for taking the time to complete this survey

Class-Level Survey of Student Engagement: Faculty Version

IOWA STATE UNIVERSITY

CLASSE Faculty
Classroom Survey of Student Engagement*

This survey asks about your perception of the importance of various activities and practices occurring in your AgEdS 450 class. Your honest and straightforward responses to these questions will help us to identify targets for improvements within the course.

Part I: Engagement Activities

For students to be successful in your AgEdS 450 class, how important is it that they	Not Important	Somewhat Important	Important	Very Important
1. Ask questions during your AgEdS 450 class	☐	☐	☐	☐
2. Contribute to class discussions that occur during your AgEdS 450 class	☐	☐	☐	☐
3. Prepare two or more drafts of a paper or assignment in your AgEdS 450 class before turning it in	☐	☐	☐	☐
4. Work on a paper or a project in your AgEdS 450 class that requires integrating ideas or information from various sources	☐	☐	☐	☐
5. Include diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments in your AgEdS 450 class	☐	☐	☐	☐
6. Come to your AgEdS 450 class having completed readings or assignments	☐	☐	☐	☐
7. Work with other students on projects **during** your AgEdS 450 **class**	☐	☐	☐	☐
8. Work with classmates **outside of** your AgEdS 450 **class** to prepare class assignments	☐	☐	☐	☐
9. Put together ideas or concepts from different courses when completing assignments or during class discussions in your AgEdS 450 class	☐	☐	☐	☐
10. Tutor or teach other students in your AgEdS 450 class	☐	☐	☐	☐
11. Use an electronic medium (list-serv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment in your AgEdS 450 class	☐	☐	☐	☐
12. Use email to communicate with you as the instructor of your AgEdS 450 class	☐	☐	☐	☐
13. Discuss grades or assignments with you as the instructor of your AgEdS 450 class	☐	☐	☐	☐
14. Discuss ideas from your AgEdS 450 with others outside of class (students, family members, coworkers, etc.)	☐	☐	☐	☐

	Not Important ▼	Somewhat Important ▼	Important ▼	Very Important ▼
15. Make a class presentation in your AgEdS 450 class	☐	☐	☐	☐
16. Participate in a community-based project (e.g., service learning) as part of your AgEdS 450 class	☐	☐	☐	☐
17. Discuss ideas from your AgEdS 450 readings or classes with you outside of class	☐	☐	☐	☐
18. Receive prompt written or oral feedback from you on their academic performance in your AgEdS 450 class	☐	☐	☐	☐
19. Work harder than they think they can to meet your standards or expectations in your AgEdS 450 class	☐	☐	☐	☐

PART II: COGNITIVE SKILLS

How important is it to you that the coursework in your AgEdS 450 class emphasize the following mental activities?	Not Important ▼	Somewhat Important ▼	Important ▼	Very Important ▼
20. **Memorizing** facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	☐	☐	☐	☐
21. **Analyzing** the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	☐	☐	☐	☐
22. **Synthesizing** and organizing ideas, information, or experiences into new, more complex interpretations and relationships	☐	☐	☐	☐
23. **Making Judgments** about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	☐	☐	☐	☐
24. **Applying** theories or concepts to practical problems or in new situations	☐	☐	☐	☐

PART III: OTHER EDUCATIONAL PRACTICES

For students to be successful in your AgEdS 450 class, how important is it that they	Not Important ▼	Somewhat Important ▼	Important ▼	Very Important ▼
25. Prepare written papers or reports of more than 5 pages in length in your AgEdS 450 class?	☐	☐	☐	☐
26. Are challenged to do their best work on the examinations they have in your AgEdS 450 class	☐	☐	☐	☐
27. Have homework assignments during a **typical week** in your AgEdS 450 class that take more than one hour each to complete?	☐	☐	☐	☐
28. Spend more than 3 hours during a **typical week** preparing for your AgEdS 450 class (studying, reading, doing homework or lab work, analyzing data, rehearsing, and other academic matters)?	☐	☐	☐	☐

For students to be successful in your AgEdS 450 class, how important is it that they	Not Important	Somewhat Important	Important	Very Important
29. Attend your AgEdS 450 class?	☐	☐	☐	☐
30. Take notes in your AgEdS 450 class?	☐	☐	☐	☐
31. Review notes prior to the next scheduled meeting of your AgEdS 450 class?	☐	☐	☐	☐
32. Participate in a study partnership with a classmate in your AgEdS 450 class to prepare for a quiz or a test?	☐	☐	☐	☐
33. Attend a review session or help session to enhance their understanding of the content of your AgEdS 450 class?	☐	☐	☐	☐
34. Are interested in learning the AgEdS 450 course material?	☐	☐	☐	☐

PART IV: CLASS ATMOSPHERE

How important are the following class atmosphere variables to the success of students in your AgEdS 450 class?	Not Important	Somewhat Important	Important	Very Important
35. Being comfortable talking with you as the instructor of the AgEdS 450 class	☐	☐	☐	☐
36. Enjoying group work with their classmates in your AgEdS 450 class	☐	☐	☐	☐
37. Finding the course material in your AgEdS 450 class to be difficult?	☐	☐	☐	☐
38. Finding the lectures easy to follow in your AgEdS 450 class?	☐	☐	☐	☐

PART V: DEMOGRAPHICS

47. Over the past 3 years, how many times have you taught this AgEdS 450 class?
☐ none, new course prep ☐ once ☐ twice ☐ 3 or more times

48. How many years of teaching experience do you have in higher education?
☐ less than 3 years ☐ 3 - 6 years ☐ 7-10 years ☐ 11 or more years

49. Approximately how many students are enrolled in this AgEdS 450 class?
☐ less than 15 students ☐ 15 - 30 students ☐ 31 - 60 students ☐ 61 or more students

Please enter your full name here:_____

Please select the course you teach:

Thank you for taking the time to complete this survey

AgEdS 450 Sociometric Questionnaire

Evaluation of Student Collaboration in AGEDS 450

Dear Student in AGEDS 450:

Student collaboration has become a part of undergraduate education in Colleges of Agriculture and Life Sciences. This class activity (research project) is to evaluate the collaboration between you and your classmates. Social Networking Analysis will be utilized to find out how students in AGEDS 450 collaborate.

If you provided informed consent, your responses will be used as part of a research study. All the students' names will be coded with a letter and number, and the questionnaires containing names and other personal information will be shredded at the conclusion of the study. You have the right to ask the researchers any question regarding this project. You also have the right to reject participation in the research portion. You may withdraw from this research any time you wish.

Your response and time is greatly appreciated.

OP McCubbins	opmcc@iastate.edu	(859) 444-3966
Thomas H. Paulsen, Ph.D.	tpaulsen@iastate.edu	(515) 294-0047
Ryan Anderson, Ph.D.	randrsn@iastate.edu	(515) 294-4193
Guang Han,	guanghan@iastate.edu	(321) 609-1327

To complete this questionnaire please answer each question with clearly legible hand writing. Please return the questionnaire to the class instructors or teaching assistants.

Your Full name: _____ Team #: _____

Age: _____ Major: _____

Lab Section: _____

Circle your school status: Freshman Sophomore Junior Senior

Circle your class committee: Buildings and Grounds Crops Custom Operations/ Swine

Finance/ Marketing Machinery Public Relations

Please circle the name(s) of students with whom you have collaboratively worked/consulted with for projects/ study/assignments/problems related to the AGEDS 450 course, and rate the level of that collaboration by circling the representative number. The rating scale is one to four, where one means a low level of collaboration and four means a high level collaboration. If you do not circle a student's name, we will assume you have not collaborated with them.
(Please circle all that apply. Names are alphabetically ordered by last name.)

An example is included below:

Student 1 (1) 2 3 4	Student 2 1 2 3 4	Student 3 1 2 3 (4)
Low level Collaboration	*No collaboration*	*High level collaboration*

Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
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Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4
Student Name	1 2 3 4

APPENDIX F. CURRICULUM VITAE

OP McCubbins

Instructor, Farm Management and Operations
Department of Agricultural Education and Studies
Iowa State University; 223C Curtiss Hall; Ames, IA 50011

ORCID

EDUCATION

August 2016 Iowa State University, Ames, Iowa
Doctor of Philosophy in Agricultural Education
Cognate Areas: Teacher Education; Team-Based Learning; Flipped Learning; Learner-Centered Instruction
Dissertation title: *Team-based learning in an undergraduate capstone course: Examining the effectiveness of a learner-centered instructional method for farm management and operation students*

December 2012 Murray State University, Murray, Kentucky
Master of Science in Agriculture
Capstone project title: *Lignin light switchgrass as an alternative fuel source*

May 2010 Murray State University, Murray, Kentucky
Bachelor of Science in Agricultural Education

Certification and Specializations

- *Graduate Student Teaching Certificate,* Graduate College, Iowa State University
- *Teacher License*, Professional Certificate for Teaching Agriculture, Grades 5 through 12, State of Kentucky
- *Certified Teacher*, Introduction to Agriculture, Food, and Natural Resources, Curriculum for Agricultural Science Education
- *MasterWrench Service,* Stihl Incorporated

PROFESSIONAL EXPERIENCE

August 2013–August 2016 **Instructor/ Graduate Assistant**
Department of Agricultural Education and Studies
Iowa State University, Ames, Iowa

Appointments
¾ time- Instructor, 2014, 2015, 2016
¼ time- Graduate teaching assistant, 2013, 2014
½ time- Climate change, mitigation, and adaption in corn-based cropping system, 2013, 2014

Teaching (Courses taught)
AgEdS 311- Presentation and Sales Strategies for Agricultural Audiences
AgEdS 450- Farm Management and Operations

Advisement/ Supervision
Collegiate FFA, Graduate Advisor, 2013 to present
Graduate Organization in Agricultural Education, President, Fall 2013 to present

Student Teaching Supervision
John Rasty, Fall 2014; Kylie Miller & Andrew Sauer, Spring 2015; Cassie Galm, Spring 2016

2011-2013 **Agricultural Education Instructor/ FFA Advisor**
Campbell County High School, Alexandria, Kentucky

Courses Taught
Agriscience, Advanced Animal Science, Animal Science/ Equine Science, Floral Design, Introduction to AFNR (CASE Certified), Introduction to Agriscience, Landscape Design/ Turf Management, Small Animal Science, Veterinary Science Technology, Wildlife Management

Advisement/ Supervision
Campbell County FFA Chapter Advisor, Sophomore Camel Learning Community Mentor, Student Agricultural Experience Programs Supervisor

Coordination
School Climate Committee Chair (2012, 2013), Curriculum Committee
Member (2011-2013), Career and Technical Education Professional Learning Community Member

2010-2011 **Agricultural Education Instructor/ FFA Advisor**
Lone Oak High School, Paducah, Kentucky

Courses Taught
Introduction to Agriscience, Greenhouse Management and Technology

Advisement/ Supervision
Lone Oak FFA Chapter Advisor, Freshman Learning Community Mentor, Student Agricultural Experience Programs Supervisor

Coordination
Career and Technical Education Professional Learning Community Member

HONORS AND AWARDS

- **NACTA Graduate Student Teaching Award,** 2016. North American Colleges and Teachers of Agriculture
- **Graduate Student Teaching Certificate,** 2016. Iowa State University, Ames, Iowa.

- **Center for the Integration of Research, Teaching and Learning Scholar,** 2016. Iowa State University, Ames, Iowa.
- **Preparing Future Faculty Associate,** 2016. Iowa State University, Ames, Iowa
- **Research Excellence Award**, 2016. Graduate College, Iowa State University, Ames, Iowa.
- **Omega II- Powerful Professional Development Participant,** 2016. American Association for Agricultural Education.
- **Outstanding Innovative Idea Poster,** 2015. North Central American Association for Agricultural Education Research Conference, Minneapolis, Minnesota.
- **Distinguished Research Poster,** 2015. National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.
- **Inaugural Inductee, Nelson County High School Athletics Hall of Fame,** 2015. Nelson County High School, Bardstown, Kentucky.
- **Outstanding Research Poster,** 2015. American Association for Agricultural Education National Research Conference, San Antonio, Texas.
- **Teaching Excellence Award**, 2015. Graduate College, Iowa State University, Ames, Iowa.
- **Teaching as Research Funding Award Recipient**, 2015. Iowa State University, Ames, Iowa.
- **Distinguished Innovative Idea Poster (Second Place),** 2014. National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.
- **Distinguished Innovative Idea Poster,** 2014**.** American Association for Agricultural Education National Research Conference, Snowbird, Utah.
- **Best Research Poster,** 2014. Graduate and Professional Student Senate Research Conference, Iowa State University, Ames, Iowa.
- **Faculty Pride Pin,** 2013 (3 time recipient)**,** 2012 (2 time recipient), Campbell County High School, Alexandria, Kentucky
- **Outstanding Senior Man,** 2010, School of Agriculture. Murray State University, Murray, Kentucky
- **Workhorse Award,** 2010. Collegiate FFA, Murray State University, Murray, Kentucky
- **Outstanding Member Award,** 2008. Collegiate FFA, Murray State University, Murray, Kentucky

PUBLICATIONS

Peer-Reviewed Journal Articles

1. Han, G., **McCubbins, OP,** and Paulsen, T. H. (2016). Utilizing Social Network Analysis to Measure Student Collaboration in an Undergraduate Capstone Course. *NACTA Journal*, *60*(2), 176-182. **Invited article**

2. **McCubbins, OP**, Paulsen, T. H., and Anderson, R. (in press). Student perceptions concerning their experience in a flipped undergraduate capstone course. *Journal of Agricultural Education*.

3. **McCubbins, OP**, Wells, K. T., Anderson, R., and Paulsen, T. H. (in press). Teacher-perceived adequacy of tools and equipment to teach agricultural mechanics. *Journal of Agricultural Education*.

Manuscripts in Progress

1. **McCubbins, OP**, Paulsen, T. H., and Anderson, R. (in progress). *Integrating Team-Based Learning in an Undergraduate Capstone Course: Advice from Larry Michaelsen*.

2. **McCubbins, OP**, Anderson, R., and Paulsen, T. H. (in progress). *The relationship of the adequacy of tools and equipment to perceived competency to teach agricultural mechanics topics in high school agricultural mechanics laboratories.*

3. Haynes, J. C., Anderson, R., and **McCubbins**, **OP.** (in progress). *Determining the teaching resources needed for an ideal post-secondary applied STEM (agricultural mechanics) learning laboratory: A Delphi approach*.

Peer-Reviewed Paper Presentations

1. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2016, June). *Utilizing Social Network Analysis in a Team-Based Learning Formatted Capstone Course.* Paper to be presented at the North American Colleges and Teachers of Agriculture Conference, Honolulu, HI.

2. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2016, June). *Classroom Level Student Engagement in a Team-Based Learning Course.* Paper to be presented at the North American Colleges and Teachers of Agriculture Conference, Honolulu, HI.

3. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2015, October). *Student Perceptions of Their Experience in a Flipped Undergraduate Capstone Course.* North Central Region American Association for Agricultural Education Conference, Minneapolis, MN.

4. **McCubbins, OP**, Anderson, R., and Paulsen, T. H. (2015, October). *The relationship between competency and adequacy of tools and equipment available to teach agricultural mechanics skills in secondary agricultural mechanics laboratories.* North Central Region American Association for Agricultural Education Conference, Minneapolis, MN.

5. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2015, June). *Flipping an Undergraduate Capstone Course: Student Perceptions of their Experience in a TBL Formatted Course.* Paper presented at the North American Colleges and Teachers of Agriculture Conference, Athens, GA.

6. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2015, June). *Integrating Team-Based Learning in an Undergraduate Capstone Course: Advice from Larry Michaelsen.* Paper presented at the North American Colleges and Teachers of Agriculture Conference, Athens, GA.

7. **McCubbins, OP**., Anderson, R. & Paulsen, T. (2014, October). *Teacher-perceived Adequacy of Tools and Equipment Available to Teach Agricultural Mechanics.* North Central Region American Association for Agricultural Education Conference, Morgantown, WV.

Published Abstracts

1. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2016, June). *Utilizing Social Network Analysis in a Team-Based Learning Formatted Capstone Course. Paper Abstract, North American Colleges and Teachers of Agriculture Conference*, Honolulu, HI.

2. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2016, June). *Classroom Level Student Engagement in a Team-Based Learning Course. Paper Abstract, North American Colleges and Teachers of Agriculture Conference*, Honolulu, HI.

3. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2015, June). *Flipping an Undergraduate Capstone Course: Student Perceptions of their Experience in a TBL Formatted Course.* Paper presented at the North American Colleges and Teachers of Agriculture Conference, Athens, GA.

4. **McCubbins, OP**, Paulsen, T. H., & Anderson, R. (2015, June). *Integrating Team-Based Learning in an Undergraduate Capstone Course: Advice from Larry Michaelsen.* Paper presented at the North American Colleges and Teachers of Agriculture Conference, Athens, GA.
5. **McCubbins, OP**, Paulsen, T., & Anderson, R. (2015, June). Utilizing snapchat to prepare for career development events. *Poster Abstract, North American Colleges and Teachers of Agriculture Conference,* Athens, GA.

6. **McCubbins, OP**, Paulsen, T., & Anderson, R. (2015, June). Providing immediate feedback for learners by utilizing gradecam. *Poster Abstract, North American Colleges and Teachers of Agriculture Conference,* Athens, GA.

7. Han, G., Paulsen, T. H., **McCubbins, OP**, & Caudle, L. (2014, June). Evaluation of student collaboration in a capstone agriculture course through social network analysis. *Poster Abstract, North American Colleges and Teachers of Agriculture Conference*, Bozeman, MT.

8. Caudle, L., Paulsen, T. H., **McCubbins, OP**, and Han, G. (2014, June). Identifying critical thinking skills in a capstone agriculture course. *Poster Abstract, North American Colleges and Teachers of Agriculture Conference*, Bozeman, MT.

Peer-Reviewed Posters

1. **McCubbins, OP**, Paulsen, T. H., and Anderson, R. (2016, May) *Examining student engagement in a flipped classroom.* Poster to be presented at the American Association for Agricultural Education Conference, Kansas City, MO.

2. **McCubbins, OP**, Anderson, R., Frutchey, R., and Rasty, J. (2016, May) *Team-based learning: A professional development model for training the trainer.* Poster to be presented at the American Association for Agricultural Education Conference, Kansas City, MO.

3. **McCubbins, OP**, Paulsen, T. H., Anderson, R. and Bender, H. (2016, March) *Utilizing the tuning protocol to critically evaluate team-based learning modules and components.* Poster presented at the International Team-Based Learning Collaborative Conference, Albuquerque, NM.

4. **McCubbins, OP**, Anderson, R., Frutchey, R., and Rasty, J. (2016, March) *Team-based learning: A professional development model for training the trainer.* Poster presented at the International Team-Based Learning Collaborative Conference, Albuquerque, NM.

5. Frutchey, R., **McCubbins, OP**, Anderson, R., and Rudolphi, J. (2016, March) *Utilizing facebook profile worksheets to enhance higher order thinking skills in team-based learning courses.* Poster presented at the International Team-Based Learning Collaborative Conference, Albuquerque, NM.

6. Haynes, J. C., Anderson, R., and **McCubbins**, **OP.** (2015, October). *Determining the teaching resources needed for an ideal post-secondary applied STEM (agricultural mechanics) learning laboratory: A Delphi approach*. Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY. **Distinguished Research Poster**

7. **McCubbins, OP**. (2015, October). *One app to rule them all: Utilizing plickers for formative assessment.* Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.

8. **McCubbins, OP**. (2015, October). *Immediate feedback on formative assessments: GradeCam as a useful classroom tool.* Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.

9. **McCubbins, OP**. (2015, October). *There's an app for that: utilizing plickers for formative assessment.* Poster presented at the North Central Region meeting of the American Association for Agricultural Education, Minneapolis, MN. **Outstanding Innovative Idea Poster**

10. **McCubbins, OP**. (2015, May). *Utilizing gradecam to foster immediate feedback for learners*. Poster presented at the American Association for Agricultural Education Conference, San Antonio, TX.

11. **McCubbins, OP**, Paulsen, T., & Anderson, R. (2015, May). *Student perceptions of their experience in a flipped undergraduate capstone course*. Poster presented at the American Association for Agricultural Education Conference, San Antonio, TX. **Outstanding Research Poster**

12. McQuillen, J., **McCubbins, OP**, Paulsen, T., & Anderson, R. (2015, May). *Getting students to go kahoot for assessments.* Poster presented at the American Association for Agricultural Education Conference, San Antonio, TX.

13. Caudle, L., **McCubbins, OP**. Paulsen, T., & Anderson, R. (2015, May). *Public service announcement: Spreading farm safety awareness through the use of the mobile application, glide.* Poster presented at the American Association for Agricultural Education Conference, San Antonio, TX.

14. **McCubbins, OP**, Paulsen, T. H. Anderson, R. (2015, March). *Utilizing gradecam to foster immediate feedback for learners.* Poster presented at the International Team-Based Learning Collaborative Conference, St. Petersburg, FL.

15. **McCubbins, OP**, Anderson, R., & Paulsen, T. H. (2014, October). *Enhancing career development event preparation using Snapchat: A snapshot of identification components of various career development events.* Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.

16. Caudle, L., **McCubbins, OP**. Paulsen, T., & Anderson, R. (2014, October). *Public service announcement: Spreading farm safety awareness through the use of the mobile application, glide.* Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY. **Second Place- Distinguished Innovative Idea Poster**

17. **McCubbins, OP**, Anderson, R., & Paulsen, T. H. (2014, October). *Enhancing career development event preparation using Snapchat: A snapshot of identification components of various career development events.* Poster presented at the North Central Region meeting of the American Association for Agricultural Education, Morgantown, WV.

18. Caudle, L., **McCubbins, OP**. Paulsen, T., & Anderson, R. (2014, October). *Public service announcement: Spreading farm safety awareness through the use of the mobile application, glide.* Poster presented at the North Central Region meeting of the American Association for Agricultural Education, Morgantown, WV. **Outstanding Research Poster**

19. **McCubbins, OP**, Wells, K. T., Anderson, R., & Paulsen, T. H. (2014, May). *Enhancing agricultural mechanics laboratory awareness with Snapchat: A snapshot of agricultural mechanics.* Poster presented at the American Association of Agricultural Educators conference, Snowbird, UT. **Distinguished Innovative Idea Poster**

20. **McCubbins, OP**, Wells, K. T., Anderson, R., & Paulsen, T. H. (2014, April). *Teacher-perceived adequacy of tools and equipment to teach agricultural mechanics.* Poster presented at the Graduate and Professional Student Senate Research Conference, Ames, IA. **Best Poster**

21. **McCubbins, OP**, Wells, K. T., Anderson, R., Paulsen, T. H. (2013, December). *Teacher-perceived adequacy of tools and equipment to teach agricultural mechanics.* Poster presented at the National Association of Agricultural Educators conference, Las Vegas, NV.

22. **McCubbins, OP**, Wells, K. T., Anderson, R., & Paulsen, T. H. (2013, December). *The relationship of the adequacy of tools and equipment to perceived competency to teach agricultural mechanics topics in high school agricultural mechanics laboratories.* Poster presented at the Association for Career and Technical Education Research Conference, Nashville, TN.

23. **McCubbins, OP**, Wells, K. T., Anderson, R., Paulsen, T. H. (2013, September). *Teacher-perceived adequacy of tools and equipment to teach agricultural mechanics.* Poster presented at the National Agricultural Mechanics Blue Ribbon Conference, Louisville, KY.

24. **McCubbins, OP**, Wells, K. T., Anderson, R., Paulsen, T. H. (2013, September). *Teacher-perceived adequacy of tools and equipment to teach agricultural mechanics.* Poster presented at the North Central Region meeting of the American Association for Agricultural Education, Platteville, WI.

Other Publications

1. **McCubbins, OP.** (2015, August 3). Introduction to GradeCam. [Video file]. Video created for the Center for Excellence in Learning and Teaching, Iowa State University. Video available at https://www.youtube.com/watch?v=Iz8DdgIDDcA.

2. **McCubbins, OP.** (2015, August 3). What is Team-Based Learning? [Video file]. Video created for the Center for Excellence in Learning and Teaching, Iowa State University. Video available https://www.youtube.com/watch?v=kN8mebiIWFc

3. **McCubbins, OP.** (2015, June). Providing immediate feedback to learners: Utilizing web 2.0 technologies to guide clarifying instruction. *Team-Based Learning Trends, 5*(2). **Invited Newsletter Article**

4. **McCubbins, OP**. (2013, March/ April). STEM concepts in my agriculture classroom: Opinions and suggestions on STEM and its incorporation. *The Agricultural Education Magazine, 85*(5), p. 24-25.

OUTREACH WORKSHOPS/ INVITED PRESENTATIONS

Teacher Professional Development

1. Anderson, R. G., **McCubbins, OP**, Rasty, J. R., and Frutchey, R. (2016, May). *Agricultural mechanics boot camp*. Workshop delivered to pre-service Agricultural Education teachers from five states, Iowa State University, Ames, IA.

2. **McCubbins, OP**, Anderson, R. G., Rasty, J. R., and Frutchey, R. (2016, February). *Woodworking Projects for the Applied Learning Laboratory: Mason Jar Candy Dishes.* Workshop delivered to in-service Agricultural Education and Industrial Technology teachers from two states. Iowa State University, Ames, IA.

3. **McCubbins, OP**, Anderson, R. G., Rasty, J. R., and Frutchey, R. (2015, December). *Accelerated Torchmate Training: Advanced CAD programming techniques and cutting procedures.* Workshop delivered to in-service Agricultural Education and Industrial Technology teachers from two states. Iowa State University, Ames, IA.

4. **McCubbins, OP**, Anderson, R. G., Rasty, J. R., and Frutchey, R. (2015, November). *Torchmate 101: Introduction to CAD programming and automated CNC tables.* Workshop delivered to in-service Agricultural Education and Industrial Technology teachers from two states. Iowa State University, Ames, IA.

5. **McCubbins, OP**, Anderson, R. G., Rasty, J. R., and Frutchey, R. (2015, July). *Welding boot camp.* Workshop delivered to in-service Agricultural Education teachers and Industrial Technology teachers from seven states. Iowa State University, Ames, IA.

6. Anderson, R. G., **McCubbins, OP**, Rasty, J. R., and Frutchey, R. (2015, May). *Agricultural mechanics boot camp*. Workshop delivered to pre-service Agricultural Education teachers from five states, Iowa State University, Ames, IA.

7. **McCubbins, OP**, Anderson, R. G., and Rasty, J. R. (2015, April). *Budget friendly woodworking.* Workshop delivered to in-service Agricultural Education and Industrial Technology teachers from Iowa. Iowa State University, Ames, IA.

8. **McCubbins, OP**, Frescoln, L., Miller, W. W. (2014, June). *Educating the next generation on climate change and agriculture.* Workshop delivered to in-service Agricultural Education and Science teachers from three states. Iowa State University, Ames, IA.

9. Byrd, A. P., **McCubbins, OP**, Anderson, R. G. (2014, May). *Arc welding for beginners*. Workshop presented to in-service Agricultural Education teachers in Iowa. Iowa State University, Ames, IA.

10. Byrd, A. P., **McCubbins, OP**, Anderson, R. G. (2014, March). *Oxy-fuel welding for beginners*. Workshop presented to in-service Agricultural Education teachers in Iowa. Iowa State University, Ames, IA.

11. Byrd, A. P., **McCubbins, OP**, Anderson, R. G. (2014, January). *MIG welding for beginners*. Workshop presented to in-service Agricultural Education teachers in Iowa. Iowa State University, Ames, IA.

12. Byrd, A. P., **McCubbins, OP**, Anderson, R. G. (2013, November). *Arc welding for beginners*. Workshop presented to in-service Agricultural Education teachers in Iowa. Iowa State University, Ames, IA.

Professional Associations Workshops/ Presentations

(*- Invited Presentation/ Workshop)

1. **McCubbins, OP,** Paulsen, T. H., & Anderson, R. (2015, November). *Team-based learning: Engaging 21st century learners in a learner-centered classroom*. Professional development workshop presented at the National Association of Agricultural Educators National meeting, New Orleans, LA.

2. **McCubbins, OP,** Paulsen, T. H., & Anderson, R. (2015, November). *Utilizing team-based learning to engage students.* Professional development IGNITE session presented at the Association for Career and Technical Education Research National meeting, New Orleans, LA.

3. **McCubbins, OP*,** Paulsen, T. H., & Anderson, R. (2015, October). *Team-based learning: Engaging students in a flipped course design*. Professional development roundtable presented at the Career and Technical Education Best Practices Conference, Phoenix, AZ.

4. Mills, F., Bender, H., Orgler, L., Ferrell, K., & **McCubbins, OP.** (2015, June). *Team-based learning "flips" the classroom. We've been "flipping" for years*. Professional development workshop presented at the North American Colleges and Teachers of Agriculture National meeting, Athens, GA.

5. **McCubbins, OP,** Paulsen, T. H., & Anderson, R. (2015, May). *Team-based learning: Engaging students in a flipped course design to meet the needs of 21st century learners*. Professional development workshop presented at the National meeting of the American Association of Agricultural Educators, San Antonio, TX.

6. **McCubbins, OP,** Paulsen, T. H., & Anderson, R. (2015, April). *Team-based learning: Engaging students in a flipped course design to meet the needs of 21st century learners*. Professional development workshop presented at the Association for International Agricultural and Extension Education, Wageningen, The Netherlands.

7. **McCubbins, OP***, Anderson, R., & Wells, T. (2014, June). *Enhancing Agricultural Mechanics Laboratory Awareness with Snapchat: A snapshot of Agricultural Mechanics Safety Concerns*. Presentation delivered to Speeding with Technology roundtable at the 60th Annual North American Colleges and Teachers of Agriculture Conference, Bozeman, MT.

University/ Departmental Invited Workshops/ Presentations

1. **McCubbins, OP**., and Vogel, G. (2016, May). *Ag 450: Opportunities for immersion in a hands-on farm management course.* Presentation delivered to the President and Agriculture Dean from Northeast Agricultural University (Heilongjiang, China), Iowa State University, Ames, IA.

2. **McCubbins, OP.** (2016, March). *Utilizing the tuning protocol to provide feedback on team-based learning module components.* Presentation delivered to faculty members in the Center for Excellence in Learning and Teaching. Iowa State University. Ames, IA.

3. **McCubbins, OP.** (2015, December). *Teaching as research in agricultural education: Examining team-based learning in a capstone course.* Presentation delivered to Preparing Future Faculty students for the Center for Excellence in Learning and Teaching. Iowa State University. Ames, IA.

4. **McCubbins, OP**, Anderson, A., Zenko, Z., Bickelhaupt, S., & Bovenmyer, K. (2015, August). *Active learning techniques for the college classroom.* Workshop presented at the University Teaching Symposium at Iowa State University, Ames, IA.

5. **McCubbins, OP** & Thomas, M. (2015, August). *Underrepresented minority graduate students: Forming a positive mentoring relationship.* Presentation delivered to Graduate College Peer Mentor trainees, Iowa State University, Ames, IA.

6. **McCubbins, OP.** (2014, December). *Team-Based Learning: How it works in a capstone farm management course.* Workshop presented to faculty and graduate students in the Department of Agricultural Education and Studies, Iowa State University, Ames, IA.

7. **McCubbins, OP**., and Vogel, G. (2014, December). *Ag 450: Opportunities for immersion in a hands-on farm management course.* Presentation delivered to potential transfer students from Joliet Junior College, Iowa State University, Ames, IA.

8. **McCubbins, OP** & Vogel, G. (2014, December). *Ag 450: How a student managed farm operates on a daily basis.* Presentation delivered to AgEdS 110 students, Iowa State University, Ames, IA.

9. **McCubbins, OP**. (2014, April). *Peer evaluations in TBL: Google forms set-up and management of data.* Presentation delivered to the Center for Excellence in Teaching and Learning- Team-Based Learning Community, Iowa State University, Ames, IA.

10. **McCubbins, OP**. (2014, March). *Utilizing GradeCam in a TBL formatted course: Tips and suggestions.* Presentation delivered to the Center for Excellence in Teaching and Learning- Team-Based Learning Community, Iowa State University, Ames, IA.

11. **McCubbins, OP**. (2014, March). *Life as a graduate student at Iowa State University.* Presentation delivered to potential graduate students hosted by the College of Agriculture and Life Sciences, Iowa State University, Ames, IA.

12. **McCubbins, OP.** (2013, October). *Shielded metal arc welding techniques in the agricultural mechanics laboratory.* Presentation delivered to AgEdS 388, Agricultural Mechanics Applications students, Iowa State University, Ames, IA.

13. **McCubbins, OP.** (2013, October). *Shielded metal arc welding applications in the agricultural mechanics laboratory.* Presentation delivered to AgEdS 388, Agricultural Mechanics Applications students, Iowa State University, Ames, IA.

14. **McCubbins, OP.** (2013, October). *Safe woodworking techniques.* Presentation delivered to AgEdS 488, Methods of Teaching Agricultural Mechanics students, Iowa State University, Ames, IA.

15. **McCubbins, OP.** (2013, October). *Laboratory management techniques.* Presentation delivered to AgEdS 488, Methods of Teaching Agricultural Mechanics students, Iowa State University, Ames, IA.

16. **McCubbins, OP**. (2013, October). *Student motivation in the secondary classroom.* Presentation delivered to AgEdS 310, Foundations of Agricultural Education Programs students, Iowa State University, Ames, IA.

Webinar Coordination

1. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, January). *CSCAP climate change webinar series: Overview of climate change with Dr. Gene Takle.* Webinar delivered to faculty and graduate students at 11 institutions.

2. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, January). *CSCAP climate change webinar series: The future of agronomy with Dr. Kendall Lamkey.* Webinar delivered to faculty and graduate students at 11 institutions.

3. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, February). *CSCAP climate change webinar series: Impact of winter rye cover crops on soil and water quality in Iowa with Dr. Tom Kaspar.* Webinar delivered to faculty and graduate students at 11 institutions.

4. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, February). *CSCAP climate change webinar series: Drainage water management with Dr. Matt Helmers.* Webinar delivered to faculty and graduate students at 11 institutions.

5. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, February). *CSCAP climate change webinar series: Climate science communication with Laura Edwards.* Webinar delivered to faculty and graduate students at 11 institutions.

6. **McCubbins, OP**, Frescoln, L., and Miller, W. W. (2014, February). *CSCAP climate change webinar series: Economics of different land use with Dr. John Tyndall.* Webinar delivered to faculty and graduate students at 11 institutions.

TEACHING/MENTORING

Courses Taught

Sem. & Yr.	Course #	Course Title	Enrollment	Responsibility %
Summer 2016	AgEdS 450	Farm Management & Operations	13	100
Spring 2016	AgEdS 450	Farm Management & Operations	61	100
Fall 2015	AgEdS 450	Farm Management & Operations	61	100
Summer 2015	AgEdS 450	Farm Management & Operations	17	100
Spring 2015	AgEdS 450	Farm Management & Operations	57	100
Fall 2014	AgEdS 450	Farm Management & Operations	57	100
Summer 2014	AgEdS 450	Farm Management & Operations	8	100
Spring 2014	AgEdS 450	Farm Management & Operations	51	100
Spring 2014	AgEdS 311	Presentation & Sales Strategies for Agricultural Audiences	27	100
Fall 2013	AgEdS 311	Presentation & Sales Strategies for Agricultural Audiences	24	100

Student Evaluations of Teaching

Sem. & Yr.	Course #	Total Enrollment	Response Rate	Instructor Rating	Dept. mean	Course Rating	Dept. mean
Summer 2016	AgEdS 450	13					
Spring 2016	AgEdS 450	60	95%	4.1	4.3	3.9	4.1
Fall 2015	AgEdS 450	61	77%	4.2	4.5	4.0	4.4
Summer 2015	AgEdS 450	17	53%	4.6	3.7	4.7	3.4
Spring 2015	AgEdS 450	57	72%	4.7	4.0	4.6	3.8
Fall 2014	AgEdS 450	57	51%	4.3	4.1	3.9	3.9
Summer 2014	AgEdS 450	8	17%	3.4	NA	3.7	NA
Spring 2014	AgEdS 450	51	57%	4.1	3.8	4.1	3.8
Spring 2014	AgEdS 311	27	27%	4.6	3.9	4.4	3.8
Fall 2013	AgEdS 311	24	15%	4.0	3.9	3.9	3.9

Scale: 1 = *poor*, 2 = *below average*, 3 = *average*, 4 = *above average*, and 5 = *excellent*

FUNDING ACTIVITIES

Grants ($5,989 in funding)

Year	Project Title	Investigators	Sponsor	Amount
2016	Development of a Collaborative Assessment Tool in ThinkSpace for Online TBL or Flipped Classrooms **(In Review)**	Nation, J., McCubbins, OP, Hendrich, S., Anderson, J., Berquist, E. E., Kruzich, L., Russell, A. E., Orgler, L., Gansemer-Topf, A. M., Schleining, J. A., St Germain, A., Johnson, J. S., Gillete, M. T., Bender, H. S.	USDA Higher Education Challenge Grant	$150,000
2015	Creating an Active Learning Space for Learner-Centered Instruction	McCubbins, OP	Steelcase	$62,000
2015	Measuring Student Engagement in a Flipped Undergraduate Capstone Course*	McCubbins, OP & Paulsen, T. H.	Center for the Integration of Research, Teaching, and Learning	$1,250
2015	Team-Based Learning- A Standard for Optimal Development of the "Flipped Classroom"*	Sam Houston State University Mills, F. D., Nair, S. S., Wolfskill, L. A. Iowa State University Bender, H. S., McCubbins, OP, Orgler, L. L.	Association of Public and Land-Grant Universities	$2,000
2015	Spark Something Great*	McCubbins, OP & Anderson, R. G.	Hypertherm Inc.	$2,739
2015	Use of decision-making simulation to integrate safety into a university farm management course	Mosher, G., McCubbins, OP	Central States Center for Agricultural Safety and Health	$20,000

Note. *- Funded

Professional Development Grants

Year	Project Title	Sponsor	Amount
2015	Professional Development Grant	College of Agriculture and Life Sciences	$1,300
2015	Professional Development Grant	Department of Agricultural Education and Studies	$1,300
2015	Professional Development Grant	Dr. Robert Martin	$1,000
2015	International Education in The Netherlands	College of Agriculture and Life Sciences	$1,500
2015	Professional Development Grant	Graduate and Professional Student Senate	$250
2015	Professional Development Grant	Department of Agricultural Education and Studies	$1,500
2014	Professional Development Grant	College of Agriculture and Life Sciences	$1,500
2014	Professional Development Grant	Graduate and Professional Student Senate	$250
2014	Professional Development Grant	Department of Agricultural Education and Studies	$1,500
2013	Professional Development Grant	Graduate and Professional Student Senate	$250
2013	Professional Development Grant	Department of Agricultural Education and Studies	$1,500
		Total:	$11,850.00

In-Kind Donations

Year	Company/ Organization	Amount
2016	Palmetto Industrial- Industrial Generator/Pressure Washer/ Trash Pump	$21,000
2016	Meridian Manufacturing- Titan SR2 Seed Tender	$18,000
2016	John Deere Intelligence Group- Cloud storage for field data	$2,500
2015	ATP Publishers- Agricultural Mechanics Textbooks	$3,125
2015	Delmar Cengage Publishers- Agricultural Mechanics Textbooks	$4,272
2015	Goodheart-Wilcox- Modern Welding Textbooks	$2,900
2015	John Deere Intelligence Group	$2,500
2014	John Deere Intelligence Group	$2,500
2013	Kohler Educational Program Assistant- Small Engines Donation	$5,000
	Total:	$61,797.00

SERVICE

Professional Service

American Association for Agricultural Education (AAAE)

- Manuscript Reviewer
  - National research conference
    - 2016: 4 manuscripts reviewed
- Poster Reviewer
  - National research conference
    - 2016: 7 abstracts reviewed
    - 2015: 3 abstracts reviewed
    - 2014: 5 abstracts reviewed
  - North Central Region
    - 2013: 5 abstracts reviewed
  - Southern Region
    - 2015: 6 abstracts reviewed
  - Western Region
    - 2016: 6 abstracts reviewed
- Research Session Facilitator
  - National research conference, 2014, 2016
  - North Central Region, 2014, 2015
- Special Interest Groups
  - Teacher Education, Member, 2014, 2016
  - Teacher Recruitment and Retention, Member, 2015
- Teacher Education Caucus, Member, 2015, 2016

Association for Career and Technical Education Research

- Manuscript Reviewer
  - National research conference
    - 2016: 3 manuscripts reviewed

Iowa FFA Association
- American Degree Application, Consultant, 2013
- Iowa FFA Agriscience Fair, Judge, 2014, 2015, 2016
- National Chapter Awards, Judge, 2014, 2015
- State Star Awards, Judge, 2014, 2015
- State Agricultural Mechanics Contest, Judge, 2014, 2015, 2016
- American FFA Degrees, Reviewer, 2014, 2015

State Science and Technology Fair of Iowa
- Middle School Science Fair, Judge, 2014, 2015

National FFA Organization
- Agricultural Technology and Mechanical Systems Contest, Judge, 2013, 2014, 2015
- SAE Grant Applications, Reviewer, 2015

National Agricultural Mechanics Blue Ribbon Professional Development Conference
- Poster Judge
  - National Conference: 2014
- Poster Reviewer
  - National Conference: 2013
- Paper Presentation Judge
  - National Conference: 2013

National Council for Agricultural Education
- Plant Systems pathway, Subject Matter Expert, 2014, 2015
- Power, Structural, and Technical Systems pathway, Subject Matter Expert, 2014, 2015

University Service

College Service

College of Agriculture and Life Sciences
- George Washington Carver Graduate School Panel, Panel Member, 2016
- Graduate Student Recruitment Panel, Moderator, 2014
- National FFA Convention Recruitment Booth, Volunteer Recruiter, 2013, 2014, 2015

Graduate College
- Underrepresented Minorities in Graduate Programs, Peer Mentor, 2014, 2015, 2016
- Graduate Student Academic Writing Group, Member, 2013, 2014, 2015
- Graduate and Professional Student Senate Research Conference, Moderator, 2014

Center for Excellence in Teaching and Learning
- Team-Based Learning Faculty Learning Community, Member, 2013, 2014, 2015
  - Peer Assessment Tool Creation, Member, 2015
  - Designing Team-Based Learning Classrooms, Member, 2014, 2015
- Team-Based Learning Scholars, Member, 2015, 2016
- Inspired by Teaching and Learning Community, Member, 2014, 2015
- Teaching as Research Community, Member, 2015, 2016

Departmental Service

Department of Agricultural Education and Studies, Iowa State University

- Curriculum Committee, Member, 2013, 2014, 2015, 2016
- Visiting Ugandan Students, Tour Leader, 2013
- Agricultural Entrepreneurship Initiative Business Plan Presentations, Panelist/ Judge, 2013, 2014

PROFESSIONAL DEVELOPMENT

Professional Development

- Every Summer Needs a Plan. National Center for Faculty Development and Diversity. Participant, May, 2016

- OMEGA II: Power Professional Growth. A professional development program from the American Association for Agricultural Education. Participant, February – October, 2016

- Preparing Future Faculty program. Iowa State University, Ames, Iowa. Participant, August, 2015-August, 2016

- Stihl MasterWrench Service Technician: 2-Cycle Engine Training. Training presented by Stihl, Inc. Virginia Beach, Virginia. Participant, July, 2014

- Navigating Difficult Agriscience Concepts: An Interactive Workshop on Learner-Centered Instruction. Workshop developed and delivered by the University of Kentucky, Purdue University, and the United States Department of Agriculture. Carrollton, Kentucky. **Invited participant,** April 24-25, 2014

- Protecting Human Research Participants. Training provided by the Office for Responsible Research in conjunction with the National Institutes of Health Office of Extramural Research at Iowa State University, Ames, Iowa. Completer, January, 2014

- Sexual Misconduct, Sexual Assault, and Sexual Harassment Involving Students Training. Training provided by the Graduate College, Iowa State University, Ames, Iowa. Participant, January, 2014

- Discrimination and Harassment Training. Training provided by the Graduate College, Iowa State University, Ames, Iowa. Participant, January, 2014

- Safe Zone 101. Training provided by the LGBT Student Services Office, Iowa State University, Ames, Iowa. Participant, 2014

Other Professional Development

#TeachAgChat Series

- The Latest Generation of National FFA Educational Resources (June, 2016). Hosted by the National FFA Educational Development Team and Penn State University Agricultural Education Teacher Candidates. Participant.

- Application of Experiential Learning (March, 2016). Hosted by the Iowa State Ag 450 Farm and Penn State University Agricultural Education Teacher Candidates. **Planner/ Co-host**.

- Service Learning in FFA (March, 2016). Hosted by the Idaho FFA Association and Penn State University Agricultural Education Teacher Candidates. Participant.

- Careers on Agriculture and the Food Industry: The Role of Agricultural Education (February, 2016). Hosted by the Pennsylvania Department of Agriculture and Penn State University Agricultural Education Teacher Candidates. Participant.

- Classroom management: Helping students find their maximum potential (January, 2016). Hosted by the Tennessee Association of Agricultural Educators and Penn State University Agricultural Education Teacher Candidates. Participant.

- What is the role of secondary agriculture education in preparing students for successful careers after graduation? (October 2015). Hosted by Penn State University Agricultural Education Teacher Candidates. Participant.

- Opportunities and challenges with technology regarding School Based Agriculture Education (October 2015). Hosted by Penn State University Agricultural Education Teacher Candidates. **Invited Expert.**

PROFESSIONAL ASSOCIATIONS and CONFERENCES

Professional Organizations/Association Memberships:

- Alpha Zeta, Member, 2008-Present
- Alpha Tau Alpha, Member, 2006-2010
- American Association for Agricultural Education (AAAE), Member, 2013-Present
- Association for Career and Technical Education (ACTE), Member, 2013-Present
- Association for Career and Technical Education Research (ACTER), Member, 2013-Present
- Association of International Agricultural and Extension Education (AIAEE), Member, 2015-Present
- Iowa Association of Agricultural Education (IAAE), Member, 2013-Present
- Kentucky Association of Agricultural Education (KAAE), Member, 2006-2013
- National Association of Agricultural Education (NAAE), Member, 2013-Present
- National Association of Parliamentarians (NAP), Member, 2015-Present
- National Center for Faculty Development and Diversity, Member, 2015-Present
- North American Colleges and Teachers of Agriculture (NACTA), Member, 2013-Present

- Team-Based Learning Collaborative (TBLC), Member, 2013-Present

Conferences Attended

1. North American Colleges and Teachers of Agriculture Annual Conference. Honolulu, HI. June, 2016.

2. American Association for Agricultural Education (AAAE) Annual National Research Conference. Kansas City, MO. May, 2016.

3. International Team-Based Learning Collaborative Annual Professional Development and Research Conference. Albuquerque, NM. March, 2016.

4. Global Learning in Agriculture Conference. Virtual Conference. January, 2016.

5. Association for Career and Technical Education and Research and Annual Conference. New Orleans, LA. November, 2015.

6. National Association of Agricultural Educators Annual Conference. New Orleans, LA. November, 2015.

7. Alpha Tau Alpha National Professional Honorary Agricultural Education Organization Annual Conclave. Louisville, KY. October, 2015.

8. National Agricultural Mechanics Blue Ribbon Annual Professional Development and Research Conference. Louisville, KY. October, 2015.

9. North Central American Association for Agricultural Education (NC AAAE) Annual Meeting. Minneapolis, MN. October, 2015

10. Association for Career and Technical Education Best Practices and Innovations Conference. Phoenix, AZ. September, 2015.

11. Iowa Association of Career and Technical Education Annual Conference. Ankeny, IA. June, 2014.

12. North American Colleges and Teachers of Agriculture Annual Conference. Atlanta, GA. June, 2015.

13. American Association for Agricultural Education (AAAE) Annual National Research Conference. San Antonio, TX. May, 2015.

14. Association for International Agricultural and Extension Education Annual Conference. Wageningen, The Netherlands. April/May, 2015.

15. International Team-Based Learning Collaborative Annual Professional Development and Research Conference. St. Petersburg, FL. March, 2015.

16. Association for Career and Technical Education and Research and Annual Conference. Nashville, TN. November, 2014.

17. National Association of Agricultural Educators Annual Conference. Nashville, TN. November, 2014.

18. Alpha Tau Alpha National Professional Honorary Agricultural Education Organization Annual Conclave. Louisville, KY. October, 2014.

19. National Agricultural Mechanics Blue Ribbon Annual Professional Development and Research Conference. Louisville, KY. October, 2014.

20. Iowa Association of Career and Technical Education Annual Conference. Ankeny, IA. June, 2014.

21. North American Colleges and Teachers of Agriculture Annual Conference. Bozeman, MT. June, 2014.

22. American Association for Agricultural Education (AAAE) Annual National Research Conference. Snowbird, UT. May, 2014.

23. International Team-Based Learning Collaborative Annual Professional Development and Research Conference. Ft. Worth, TX. March, 2014.

24. Association for Career and Technical Education and Research and Annual Conference. Las Vegas, NV. November, 2013.

25. National Association of Agricultural Educators Annual Conference. Las Vegas, NV. November, 2013.

26. Alpha Tau Alpha National Professional Honorary Agricultural Education Organization Annual Conclave. Louisville, KY. October, 2013.

27. National Agricultural Mechanics Blue Ribbon Annual Professional Development and Research Conference. Louisville, KY. October, 2013.

28. North Central American Association for Agricultural Education (NC AAAE) Annual Meeting. Plateville, WI. October, 2013