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A Tale of Two Courses: Exploring Teaching Teamwork Through Experiential Team Projects

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Abstract

According to employers, college graduates should possess interpersonal skills including the ability to work in and lead teams. Many instructors incorporate group projects in their courses to encourage student development of teamwork and leadership skills through experience. Research suggests, however, these skills must be taught explicitly. To test this, we explored overt and covert approaches to teaching teamwork in classes implementing experiential learning through team projects. We assessed individual and team-level outcomes at the beginning and end of a 16-week semester across both courses. Students receiving overt instruction reported significant increases across all five measured domains of individual teamwork skills. Students receiving covert instruction reported significant increases in only one domain, project planning. For team level outcomes, only students receiving covert instruction showed a significant increase in psychological safety over the course of the semester. The major implication of this research is if individual teamwork skill development is a course learning objective, instructors should consider explicitly teaching teamwork. Further research is needed to investigate the limited change in student team-level outcomes between overt and covert teamwork teaching approaches.

Introduction

Employers continue to lament the gap between their expectations and college graduates' interpersonal skills (Chamorro-Premuzic & Frankiewicz, 2019; Hart Research Associates, 2016). Chamorro-Premuzic and Frankiewicz (2019) suggested leadership, specifically, is a critical need because people frequently enter leadership positions with little or no formal education in how to lead. Additionally, Hart Research Associates (2016) reported employers endorse broad learning and prioritization of skills and knowledge that cut across college majors, including teamwork. Hendrix and Morrison (2018) found agricultural undergraduates agree, indicating "working well with others" as the most important workforce readiness skill to possess (p. 221). Effectively leading teams requires unique leadership processes (Morgeson et al., 2010; Zaccaro et al., 2001). As many organizations move toward a flatter organizational structure, it becomes increasingly important for college graduates to be well equipped with teamwork and team leadership knowledge and skills (Anicich et al., 2024).

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Literature Review and Conceptual Framework

Teaching Teamwork and Team Leadership

Educators have experimented with different ways to teach teamwork. Cletzer et al. (2022) identified 17 team and group leadership courses taught in departments of agricultural education nationwide. The dominant theme and purpose of these courses was to overtly teach students how to work in and provide leadership for groups and teams in the context of the agriculture industry. Other pedagogical approaches are more covert, for example, assigning a group project in which students experience working in teams, thereby acquiring teamwork skills (Britton et al., 2017; Hobson et al., 2014; Layne et al., 2019). However, some scholars have suggested specific teamwork instruction must be provided for students to successfully acquire teamwork skills through group projects (Britton et al., 2017; Kliegl & Weaver, 2014; Lamm et al., 2020; Riebe et al., 2010; Webb et al., 2004; Weinstein et al., 2013).

Incorporating teamwork instruction has been associated with positive learning outcomes. Webb et al. (2004) found teamwork training was positively related to favorable teamwork attitudes and teamwork behavior in undergraduate courses. However, they noted instructors' perceptions of the amount of teamwork instruction delivered differed significantly from students' perceptions. Weinstein et al. (2013) found improved teamwork knowledge, skills, and attitudes along with improved self-awareness of teamwork skills among law students who received integrated teamwork instruction. In fact, these students requested more teamwork training. Likewise, Hobson et al. (2014) found significant increases in overall teamwork and team leadership scores among MBA students who received explicit, multi-faceted teamwork instruction. Britton et al. (2017) also found improved teamwork skills among undergraduates when teamwork was explicitly taught and assessed. Moreover, students have reported increased ability to work well in teams after engaging in a team project through a capstone course (Layne et al., 2019).

A variety of approaches to teaching teamwork and team leadership were identified in the literature across multiple disciplines, including in the agricultural sciences. Although some scholars suggest explicit teamwork instruction is necessary for students to acquire teamwork knowledge and skills, the literature is inconsistent regarding the amount or type of instruction that is most effective.

Several indicators have been used to determine team success and teamwork effectiveness. Both individual and team-level outcomes are important to consider. The following sections describe variables that represented individual and team development in our study.

Team Learning Behavior

There has been significant research interest in team learning behavior since Senge (1990) first suggested teams represent the fundamental learning units of organizations (Nellen et al., 2020). Decuyper et al. (2010) defined team learning as "a compilation of team-level processes that circularly generates change or improvement, primarily at the level of the team, and secondary at the level of individuals or the organization" (p. 128). Team learning is driven by individual and group learned behaviors and processes that influence emergent states that can act as both inputs and outputs interacting with team development, learning, and outcomes over time (Edmondson, 1999; Marks et al., 2001; Mathieu et al., 2008; Nellen et al., 2020; Raes et al., 2015; Van den Bossche et al., 2006). The models of team learning behavior also generally support the idea that basic team learning processes and emergent states interact with and reinforce each other over time (Ilgen et al., 2005; Nellen et al., 2020; Raes et al., 2015, Van den Bossche et al., 2006)

Emergent states such as psychological safety, team potency, and satisfaction (or social cohesion) as well as basic team learning processes have been repeatedly identified as important drivers of team learning and team effectiveness (Edmondson, 1999; Nellen et al., 2020; Orsini et al., 2021; Raes et al., 2015; Van den Bossche, 2006). Basic team learning processes consist of sharing, co-construction, and constructive conflict (Decuyper et al., 2010). An additional component of team learning behavior introduced by Raes et

al. (2015) was the connection between stages of group development and stages of team learning. In their study, Raes et al. (2015) used a model of team learning put forward by Dechant et al. (1993) that argued team learning behaviors develop and emerge through four stages over time. This model was merged with Wheelan's (2005) four phases of group development to present a combined model demonstrating how social conditions that a team develops over time influence emergent states and basic team learning processes (Raes et al., 2015).

Despite the importance of member interactions described in team learning literature, the model presented by Decuyper et al. (2010) is one of few that specifically address individual level teamwork skills that could influence the emergent states and basic team learning processes. In this context, it is important to consider how team members acquire individual knowledge through their own learning, how they express and share that knowledge with other members of the group, and how relative skill and execution of these individual processes influence emergent states, basic team learning processes, and the stages of group development (Decuyper et al., 2010; Raes et al., 2015).

Individual Teamwork Skills

Although several quantitative measures of teamwork skills exist, many have only fair or even inadequate psychometric properties (Varela & Mead, 2018). Vaughan et al. (2019) used a Mokken scale analysis (MSA) to analyze the TeamUP survey instrument developed by Hastie (2018) and Parratt et al. (2016). The peer and self-assessment rubric measures teamwork skills across five domains: (a) project planning, (b) fostering a team climate, (c) facilitating the contribution of others, (d) managing conflict, and (e) contributing to team project. The TeamUP rubric was developed through a rigorous Delphi method and the content validation index values of the study ranged from 77% to 93% (Vaughan et al., 2019). The domains in the TeamUP rubric proved to be transferrable across disciplines and were identified in previous literature as teamwork skills (Britton et al., 2017; Sinche et al., 2017; Vaughan et al., 2019).

Psychological Safety

Psychological safety is often referred to as a catalyst emergent state in the team learning literature (Nellen et al., 2020; Van den Bossche et al., 2006). Catalyst emergent states are variables that reinforce team learning processes and have been viewed as cognitive, motivational, or affective states of teams (Marks et al., 2001; Mathieu et al., 2008). Psychological safety was first identified by Edmondson (1999) and has been defined as "a shared belief that the team is safe for interpersonal risk-taking" (Van den Bossche et al., 2006, p. 499). Edmondson further clarified that psychological safety is driven by mutual respect and trust between team members and "the confidence that the team will not embarrass, reject, or punish someone for communicating their opinion" (p. 354). In their comprehensive literature review of the effect of organizational drivers of team learning behavior, Nellen et al. (2020) identified 16 studies that demonstrated a definitive positive relationship between psychological safety and team learning. Given the immense amount of literature supporting the importance to team learning, psychological safety was included as a variable of interest in this study.

Group Potency

Shea and Guzzo (1987) defined group potency as "the collective belief of group members that the group can be effective" (p. 26). The concept of group potency stems from the idea of self-efficacy as described by Bandura (1982). Higher levels of group potency positively influence the collective motivation and performance of the group (Cohen & Bailey, 1997). This increased motivation and confidence should improve a team's ability to persevere through adversity, more effectively regulate team learning processes, and encourage advancement to higher stages of group development (Gully et al. 2002; Van den Bossche et al., 2006). Several studies have investigated the importance of group potency for team learning and team effectiveness (Edmondson, 1999; Shelton et al., 2010; Sundstrom et al., 2000; Van den Bossche et al., 2006). Subsequent research found group potency is important to the stages of group development and thus important for understanding how team learning behaviors evolve in groups over time (Orsini et al., 2021;

Raes et al., 2015). Given the large quantity of research supporting its importance as an additional catalyst emergent state, group potency was included as a variable of interest in this study.

Satisfaction

Anderson et al. (2001) defined relational satisfaction in a group as the "building and maintaining of member relationships during communicative processes and practices throughout the lifespan of the group" (p. 220). Satisfaction is closely related to social cohesion, which has been conceptualized as the amount of liking, caring, and closeness among group members (Nellen et al., 2020; Van den Bossche et al., 2006). Anderson et al. (2001) found satisfaction and especially consensus were significantly and highly correlated with social cohesion. Conversely, other studies did not find satisfaction or social cohesion to be a significant influencer of team learning behavior (Van den Bossche et al., 2006). Nellen et al. (2020) cited a need for additional research to elucidate the relationships between emergent states and team learning behavior. Some studies found satisfaction to be important to the stages of group development and to basic team learning processes (Orsini et al., 2021; Raes et al., 2015, Wheelan, 2005). Orsini et al. (2021) found the single most important variable to the development of team learning behavior in an undergraduate education setting was satisfaction, which was driven primarily by feelings of friendship between students and an absence of conflict. Although the research on satisfaction has been more mixed, it was included as a variable of interest in this study.

Basic Team Learning Processes (Sharing, Co-construction, and Constructive Conflict)

In their seminal review, Decuyper et al. (2010) found three basic team process variables that are essential for team learning: sharing, co-construction, and constructive conflict (Dechant et al., 1993; Edmondson, 1999; Van den Bossche et al., 2006; Wilson et al., 2007). Sharing is the process of communicating new knowledge between individual team members (Decuyper et al., 2010; Wilson et al., 2007). Co-construction is a mutual process where team members use accumulated knowledge to develop shared meanings. The process of sharing is a precondition for co-construction and requires the team to actively discuss the concept or task in question (Decuyper et al., 2010; Van den Bossche et al., 2006). Constructive conflict between team members includes a process of dialogue that illuminates diversity of opinion or identity in the group (Decuyper et al., 2010). Constructive conflict differs from regular conflict in that it does not involve personal or emotional rejection or avoidance, but rather a moderate level of task conflict that leads team members out of their comfort zones and allows for transformational learning (Decuyper et al., 2010; De Dreu & Weingart, 2003; Merriam & Baumgartner, 2020). Additional research has supported the importance of these basic team process variables to team learning and team effectiveness (Nellen et al., 2020; Raes et al., 2015).

Stages of Group Development

The emergent states and team learning processes described here are not present during the initial formation of the team. They are, instead, developed over time as individuals learn to work together (Raes et al., 2015). Dechant et al. (1993) determined there are four stages in the development of team learning processes. Parallel research on the development of teams over time found teams do not progress through the stages of team learning without great effort and interpersonal risk-taking (Edmondson, 1999). Wheelan (2009) described four stages of group development that take small groups of 4 to 14 members, between 4.6 and 8.5 months to reach the highest levels. According to Wheelan (2005), ideally, teams progress through stages of dependency and inclusion, counterdependency and fight, trust and structure, and work. A fifth stage, termination, may occur at any point in the group's lifespan. During dependency and inclusion, team members are concerned about psychological safety and rely heavily on leaders to direct the group. Eventually, teams must engage in constructive conflict to establish norms and procedures, hopefully building a climate of trust during the second stage of counterdependency and fight. In the third stage, trust and structure, team members exhibit mature negotiations about group processes and solidify positive working relationships among one another. Finally, teams move into the work stage where they focus predominantly on task achievement (Wheelan, 2005).

Raes et al. (2015) innovatively paired Wheelan's (2005) group development model and Dechant et al.'s (1993) stages of team learning to show team learning processes increase as groups progress through higher stages of group development. These higher stages of group development are characterized by more successful social conditions that include higher levels of catalyst emergent states and basic team learning processes that facilitate higher levels of team effectiveness and improved team outcomes (Decuyper et al., 2010; Orsini et al., 2021; Raes et al., 2015; Van den Bossche et al., 2006). Given how important group development is to team outcomes, the stages of group development were included as a variable of interest in this study.

Purpose and Objectives

As higher education institutions face increasing scrutiny of their purpose and value (Chamorro-Premuzic & Frankiewicz, 2019), it is important for instructors to strive to address knowledge and skills gaps identified by employers hiring college graduates, including leadership and teamwork. Therefore, the purpose of our study was to explore student outcomes related to team leadership and teamwork skills and competencies. Our research examined two approaches to teaching teamwork, overt and covert, utilizing experiential team projects. The specific research objectives were:

1. Describe individual student acquisition of teamwork skills.
2. Describe team-level outcomes related to teamwork, including team learning behavior, psychological safety, group potency, satisfaction, and stages of group development.
3. Compare individual and team-level outcomes in a course utilizing overt teamwork instruction and a course utilizing covert teamwork instruction.

Methods

Study Design

This study explored individual and team outcomes of students enrolled in two courses in the College of Agriculture and Life Sciences at the University of Florida, *Introduction to Biological Engineering* (AgEng) and *Communication and Leadership in Groups and Teams* (AgLead). Both courses included specific learning objectives of developing and applying teamwork and communication skills. Instructors of both courses integrated team projects to facilitate students' experiential learning of teamwork knowledge and skills. AgEng and AgLead were taught via synchronous online delivery during the Fall 2020 semester, using the Canvas learning management system (LMS). The AgLead course employed overt instruction on teamwork, leadership, and communication. The entire course was designed to teach leadership and communication in teams in the context of agriculture and natural resources, therefore each lesson contained learning objectives related to teamwork and leadership knowledge and skills. Conversely, the AgEng course utilized covert teamwork instruction, relying predominantly on team project assignments and the experience of completing the project to encourage students' development of teamwork knowledge and skills. One pre-recorded lesson video highlighting the benefits of teamwork, describing the stages of group development (Tuckman & Jenson, 1977), defining and identifying conditions necessary for team success (Levi, 2014), and synthesizing potential challenges and strategies to overcome said challenges was made available to the AgEng students through Canvas. However, students were not required to view the video or otherwise engage in the asynchronous lesson. In each course, the respective instructor assigned students to teams of 4 or 5 people. Teams were assigned at the end of the third week in AgLead and the beginning of the fourth week in AgEng. Students in both courses were instructed to undertake an approximately ten-week long team project. Instructors implemented similar assignments and parameters to guide student teams through their projects, including a project proposal outlining the team's intended project outcomes and their plan for completing the work, a team contract designating planned contributions of individual team members, and a final team presentation demonstrating achievement of learning objectives.

In AgEng, student teams had to identify and research a contemporary challenge or technology in biological engineering. During the seventh week of the semester, AgEng student teams completed and submitted a team contract in which they articulated their problem statement, identified experts they intended to interview, and described their plan to manage project activities to ensure team effectiveness and progress. Teams provided a timeline for completing their work that culminated in a presentation during the 14th or 15th week of the semester. The instructor provided guidance and feedback as students completed their team project assignments, but she did not teach any direct instruction lessons specifically about teamwork or how to work effectively in groups and teams.

Students in AgLead had to develop a unique project addressing a contemporary issue in agriculture, natural resources, or food sciences. Student teams completed and submitted a project proposal during the 5th week and a team contract during the 6th week of the semester. Together, these documents articulated the work the team aimed to accomplish, including specific roles and responsibilities of each team member, group norms describing how the group intended to interact and manage the project activities to ensure team effectiveness and progress, and a tentative timeline to accomplish the work. A final presentation was delivered by each team during the 14th week of the semester. Due to the nature of the course, all lessons and assignments were purposefully designed to teach students about teamwork and how to effectively work in groups and teams.

Instrumentation

In this study, individual teamwork skills, psychological safety, group potency, satisfaction, basic team learning processes, and stages of group development were analyzed over time to compare the differences in individual and team outcomes when presented with overt and covert teamwork instruction in undergraduate classes utilizing semester-long team projects. We collected data with two instruments. Individual teamwork skills were assessed using the TeamUp rubric (Vaughan et al., 2019) and team-level outcomes were assessed using the Team Evaluation Questionnaire (TEQ; Orsini et al., 2021).

The TeamUP teamwork skills self-assessment (Vaughan et al., 2019) was designed to assess self and peers however, we only analyzed the self-assessment for this research. Students in both classes completed the self-assessment during the second week of class (Time 1) and again during the 15th or 16th week (Time 2). The teamwork skills assessment consists of 32 items across 5 domains: (a) project planning, (b) fostering a team climate, (c) facilitating the contribution of others, (d) managing conflict, and (e) contributing to team project. The project planning domain indicates one's ability to work with others to plan a high quality project. Actions that foster an inclusive climate and trust within a team compose the environment domain. Facilitating contributions of others refers to actions that ensure effective team interactions. The domain of managing conflict includes items regarding how one recognizes and helps the team address conflict in a way that improves team cohesiveness. Finally, contributing to team project are the actions that demonstrate a high quality, individual contribution. It should be noted that item 7 in Domain e, was erroneously omitted from the original instrument, so no responses were collected for that item and it is not included in the analysis or results. Cronbach's alpha for each TeamUp domain at Time 1 and Time 2 were 0.78 and 0.87 for project planning, 0.84 and 0.90 for fostering climate, 0.80 and 0.85 for facilitating contribution, 0.82 and 0.91 for managing conflict, and 0.79 and 0.85 for contributing to the team. Items were measured on a seven-point scale, where 1 indicated unacceptable behavior with minimal or no demonstration of the skill and 7 indicated mastery of the skill with no improvement needed.

Students also completed the Team Evaluation Questionnaire (TEQ; Orsini et al., 2021). The first TEQ administration occurred at approximately week seven (Time 1) and the second administration occurred during week 15 (Time 2). The TEQ consisted of 50 items, measuring team-level outcomes including team learning behavior, psychological safety, group potency, satisfaction, and the four stages of group development. Cronbach's alpha for each TEQ domain at Time 1 and Time 2 were 0.90 and 0.95 for team learning behavior, 0.79 and 0.65 for psychological safety, 0.85 and 0.90 for group potency, 0.90 and 0.92

for satisfaction, 0.94 and 0.92 for Stage 4 group development, 0.85 and 0.75 for Stage 3 group development, 0.87 and 0.74 for Stage 2 group development, and 0.76 and 0.61 for Stage 1 group development. Responses were measured on a seven-point scale, where 1 = strongly disagree and 7 = strongly agree for psychological safety, the phases of group development, and group potency. The satisfaction questions were derived from the relational satisfaction scale (RSS) developed by Anderson et al. (2001) and used a five-point scale, where 1 = strongly disagree and 5 = strongly agree.

Data Collection and Analysis

In accordance with the IRB approved protocol (IRB202002002), we provided students informed consent electronically and they indicated their consent response to a researcher not otherwise associated with the courses. Links to the instruments were distributed to students by their respective instructors through the LMS and all data were collected online via Qualtrics. Data were exported to Excel for review and cleaning, and analysis was conducted in SPSS. The grand mean was calculated for each domain on the TeamUp teamwork skills self-assessment. Likewise, grand means were calculated for each team-level outcome on the TEQ. Paired samples T-tests were used to analyze differences within each class across time. Independent samples T-tests were used to analyze differences between classes at Time 1 and Time 2. The nominal alpha was adjusted by the Sidak (1967) method (1-(1-a)1/t where t = number of tests run) to control for Type I error rate, and only values below .003 were considered significant. There were ninety students enrolled in AgEng and AgLead combined. Of those, 32 were AgEng and 58 were AgLead. Of that sample, 29 AgEng students and 33 AgLead students both consented to participate and fully completed the required surveys, resulting in a final sample size of 62. One limitation of this study is not all students completed all four instruments, and some were completed incorrectly, and thus were omitted from the data analysis.

Results

Within Class Analysis

Paired samples t-tests were used to identify differences within each class on the TeamUP teamwork skills assessment and the TEQ from the beginning of the semester (Time 1) to the end (Time 2). Students in AgLead reported significant increases in all five domains on the TeamUp teamwork skills assessment (Table 1). Effect sizes measured by Cohen's *d* for these significant changes ranged from 1.52 to 2.31, which suggests a large effect for each TeamUp domain (Cohen, 1988). In AgEng, only project planning increased significantly (Table 1). The effect size measured by Cohen's *d* for this difference was .705, representing a moderate effect.

Paired sample t-tests did not detect any significant changes on the TEQ from the beginning to the end of the semester for AgLead students. However, AgEng students showed a significant increase in psychological safety over the course of the semester (Table 1). The effect size for this increase was 1.02, suggesting a large effect (Cohen, 1988).

Between Class Analysis

Independent samples t-tests were used to explore differences between classes on the TeamUp teamwork skills assessment and the TEQ. No significant differences were identified between AgEng and AgLead students at the beginning of the semester in terms of their self-assessed teamwork skills on the TeamUp rubric, meaning students in both classes perceived themselves to possess similar amounts of teamwork skill. However, at the end of the semester, AgLead students scored significantly higher than AgEng students on all five domains (Table 2 and 3). Effect sizes measured by Cohen's *d* for these significant differences ranged from 1.34 to 1.95, suggesting a large practical difference between the two classes' TeamUp assessments at the end of the semester (Cohen, 1988).

On the TEQ, independent samples t-tests found that AgLead students scored significantly higher on psychological safety, satisfaction, and group potency at the beginning of the semester compared to their

AgEng peers. The effect sizes on these differences ranged from moderate to large (Table 2). However, there were no significant differences in the TEQ at the end of the semester (Table 3).

Table 1

Paired Samples T-test for TeamUp and TEQ Assessments

Variable	Class	N	M^{T1}	SD^{T1}	M^{T2}	SD^{T2}	t	d
TeamUp								
Planning	AgEng	29	5.46	0.62	5.95	0.61	3.80*	0.71
	AgLead	33	5.76	0.36	6.79	0.68	9.97*	1.74
Environment	AgEng	29	5.73	0.82	6.08	0.72	2.58	0.48
	AgLead	33	5.61	0.74	6.81	0.13	9.45*	1.65
Facilitating Contribution	AgEng	29	5.43	0.74	5.63	0.80	1.32	0.25
	AgLead	33	5.42	0.62	6.72	0.36	9.26*	1.61
Managing Conflict	AgEng	29	5.41	0.79	5.75	0.68	2.99	0.56
	AgLead	33	5.35	0.61	6.76	0.31	13.25*	2.31
Contributing to Team Project	AgEng	29	5.70	0.75	5.96	0.58	1.87	0.35
	AgLead	33	5.76	0.65	6.78	0.34	8.76*	1.52
TEQ								
Team Learning Behavior	AgEng	29	5.99	0.67	6.18	0.70	1.64	0.30
	AgLead	33	6.36	0.74	6.35	0.79	-0.13	0.02
Stage 4 Group Development	AgEng	29	5.71	0.96	5.99	0.94	1.92	0.36
	AgLead	33	6.35	0.81	6.33	0.95	-0.14	0.03
Stage 3 Group Development	AgEng	29	5.82	0.83	5.93	0.83	0.74	0.14
	AgLead	33	6.35	0.79	6.37	0.78	0.21	0.04
Stage 2 Group Development	AgEng	29	2.73	0.99	2.80	0.85	0.49	0.09
	AgLead	33	2.83	1.75	2.50	1.34	-0.91	0.16
Stage 1 Group Development	AgEng	29	3.49	0.76	3.22	0.87	-1.96	0.36
	AgLead	33	3.14	1.66	2.96	1.08	-0.56	0.10
Group Potency	AgEng	29	5.77	0.82	5.98	0.87	1.86	0.35
	AgLead	33	6.42	0.54	6.28	0.82	1.01	0.18
Psychological Safety	AgEng	29	5.29	0.97	5.73	0.94	3.39**	1.02
	AgLead	33	6.07	0.88	6.08	0.90	-0.11	0.02
Satisfaction	AgEng	29	3.91	0.45	4.11	0.62	2.38	0.44
	AgLead	33	4.36	0.55	4.53	0.56	2.00	0.35

Note. T1 = Time 1, T2 = Time 2.
*p < .001. ** p < .002.

Table 2

Independent Samples T-Test for TeamUp and TEQ Assessments at Time One

Variable	Class	N	M	SD	t	d
TeamUp						
Planning	AgEng	29	5.46	0.62	1.84	0.65
	AgLead	33	5.76	0.68		
Environment	AgEng	29	5.73	0.82	-0.58	0.78
	AgLead	33	5.61	0.74		
Facilitating the Contribution	AgEng	29	5.43	0.74	-0.71	0.81
	AgLead	33	5.42	0.88		
Managing Conflict	AgEng	29	5.41	0.79	-0.33	0.70
	AgLead	33	5.35	0.61		
Contributing to Team Project	AgEng	29	5.70	0.75	0.32	0.70
	AgLead	33	5.76	0.65		
TEQ						
Team Learning Behavior	AgEng	29	5.99	0.67	2.05	0.71
	AgLead	33	6.36	0.74		
Stage 4 Group Development	AgEng	29	5.71	0.96	2.88	0.88
	AgLead	33	6.35	0.81		
Stage 3 Group Development	AgEng	29	5.82	0.83	2.54	0.81
	AgLead	33	6.35	0.79		
Stage 2 Group Development	AgEng	29	2.73	0.99	0.27	1.44
	AgLead	33	2.83	1.75		
Stage 1 Group Development	AgEng	29	3.49	0.76	-1.04	1.32
	AgLead	33	3.14	1.66		
Group Potency	AgEng	29	5.77	0.82	3.74*	0.95
	AgLead	33	6.42	0.54		
Psychological Safety	AgEng	29	5.29	0.97	3.31*	0.84
	AgLead	33	6.07	0.88		
Satisfaction	AgEng	29	3.91	0.45	3.53*	0.50
	AgLead	33	4.36	0.55		

* $p < 0.001$.

Table 3

Independent Samples T-Test for TeamUp and TEQ Assessments at Time Two

Variable	Class	N	M	SD	t	d
TeamUP						
Planning	AgEng	29	5.95	0.61	6.69*	1.70
	AgLead	33	6.79	0.36		
Environment	AgEng	29	6.08	0.72	5.27*	1.34
	AgLead	33	6.81	0.32		
Facilitating the Contribution	AgEng	29	6.72	0.36	7.09*	1.80
	AgLead	33	5.63	0.80		
Managing Conflict	AgEng	29	6.76	0.31	7.68*	1.95
	AgLead	33	5.75	0.68		
Contributing to Team Project	AgEng	29	5.96	0.58	6.84*	1.74
	AgLead	33	6.78	0.34		
TEQ						
Team Learning Behavior	AgEng	29	6.18	0.70	0.91	0.23
	AgLead	33	6.35	0.79		
Stage 4 Group Development	AgEng	29	5.99	0.94	1.43	0.37
	AgLead	33	6.33	0.95		
Stage 3 Group Development	AgEng	29	5.93	0.83	2.15	0.55
	AgLead	33	6.37	0.78		
Stage 2 Group Development	AgEng	29	2.80	0.85	-1.04	0.27
	AgLead	33	2.50	1.34		
Stage 1 Group Development	AgEng	29	3.22	0.87	-1.01	0.26
	AgLead	33	2.96	1.08		
Group Potency	AgEng	29	5.97	0.87	1.40	0.36
	AgLead	33	6.28	0.82		
Psychological Safety	AgEng	29	5.73	0.94	1.52	0.39
	AgLead	33	6.08	0.90		
Satisfaction	AgEng	29	4.11	0.62	2.75	0.70
	AgLead	33	4.53	0.56		

* $p < 0.001$.

Conclusions, Implications, and Recommendations

The purpose of our research was to explore differences in student teamwork knowledge and skill outcomes by examining overt and covert teaching approaches utilizing experiential learning projects. Overall, our results support previous work that suggests teamwork taught explicitly can result in positive student outcomes (Britton et al., 2017; Kliegl & Weaver, 2014; Lamm et al., 2020; Riebe et al., 2010; Webb et al., 2004; Weinstein et al., 2013). As readers will recognize, this study occurred during the COVID-19 pandemic. We would be remiss not to acknowledge the impact that event had on all learners and the learning environment. Despite the unique situation the pandemic presented, the courses we compared were as similar

as possible in structure (utilizing comparable team project assignments) and delivery (synchronous online). Additionally, we explored student outcomes in two different courses taught by two different instructors. Both courses included specific teamwork and communication learning objectives, but we acknowledge that students enrolled in agricultural leadership and agricultural engineering courses may possess inherent differences, including varying personal motivations and learning goals for classes they enroll in. However, scholars have recommended expanding research on teaching teamwork to technical content courses (Lamm et al., 2020) and this study represents an important contribution to that endeavor. Taking that into consideration, we can draw meaningful conclusions and develop useful recommendations for practice and further research.

Our first research objective was to describe individual acquisition of teamwork knowledge and skills. Means across both classes on all domains of the TeamUp rubric were between 5 and 6, suggesting all students perceived they needed minor improvements in teamwork skills. Students in AgLead, where teamwork and leadership were the focus of the course and taught explicitly, reported significant gains in individual teamwork skills at the end of the semester. Conversely, students in AgEng reported significant changes only in the domain of project planning. This result leads us to conclude explicit teamwork instruction may result in greater perceived increases in teamwork knowledge and skills than covert instruction, supporting assertions of previous research (Britton et al., 2017; Kliegl & Weaver, 2014; Lamm et al., 2020; Riebe et al., 2010; Webb et al., 2004; Weinstein et al., 2013). Despite teamwork and communication being clearly stated as course objectives on the AgEng syllabus and explicitly included as learning objectives on the team project assignment instructions, AgEng students may not have perceived teamwork as an important or relevant personal learning outcome and therefore may not have engaged in the course or project with intent to learn and improve their teamwork knowledge and skills. The significant increase in project planning skills reported by AgEng students was interesting. This domain included items such as "setting and agreeing on realistic timeframes for each part of the plan" and defining and agreeing on team goals and objectives." Perhaps this is in indicator of what they were motivated to learn through the project experience, or what skills they deemed important or relevant to their perspective career goals. Alternatively, the team contract may have served as more explicit experiential learning of this set of skills. AgEng students may have benefitted from more explicit instruction to improve their teamwork and communication skills in the other domains through their class project. Additional research is necessary to better understand why AgEng students did not perceive significant gains across all the teamwork skills domains, despite a presumably successful teamwork experience completing a class project.

The second research objective sought to describe group-level outcomes related to a teamwork learning experience. TEQ results indicated group level outcomes did not change significantly over the course of the team project for students in either course, except for psychological safety, which increased in AgEng. This result requires further investigation to better understand and interpret. Psychological safety is characterized as the shared belief the team is a safe space, where team members feel supported to take risks. Previous research indicates that in a classroom situation, the instructor may promote the perception of psychological safety as a component of the classroom environment (Orsini et al., 2021), thus, as AgEng students became more comfortable and secure in the class itself, they may have perceived greater psychological safety within their assigned team as well. Regarding students' perceptions of their group development, literature indicates it takes small groups between 4.6 and 8.5 months to reach the highest levels of group development (Wheelan, 2005). Thus, a traditional 16-week semester may not provide adequate time for a student team to authentically develop through the four stages. However, there is much to be learned about supporting team development by experiencing even the beginning stages. Moreover, teams do not have to progress to stage four development in order to accomplish tasks (Wheelan et al., 2025). Work can occur in all stages of development. This is important to consider when setting expectations for student learning and team performance. Additionally, past research on team-based learning in online environments has shown that quickly developing task processes, being familiar with relevant technologies, and efficiency in communication and collaboration were more important than team building in short-

duration educational settings (Johnson et al., 2002; Yilmaz et al., 2020). Given that both AgEng and AgLead were online in Fall 2020 and occurred over 16 weeks, it is possible teams did not prioritize group development but rather sought to accomplish the project work in the most efficient way possible. None the less, it is important to remember that the TEQ aims to measure actual group development. Although students did not perceive their group to have achieved significant levels of group development, this is not an indicator of their knowledge regarding group development. Further research on students' knowledge of group development, effective group processes, and emergent states is warranted.

The third and final objective was to compare individual and group level outcomes of students receiving overt and covert teamwork instruction. Importantly, we found no differences between AgEng and AgLead students in terms of self-perceived teamwork skills at Time 1, suggesting students in both courses perceived themselves to possess relatively similar levels of teamwork knowledge and skills. Significant differences were identified on all domains of the TeamUp rubric between groups at the end of the semester. Thus, we conclude overt teamwork instruction results in greater self-perceived gains in teamwork knowledge and skills. A major implication of this conclusion is if an instructor seeks to develop teamwork skills in students, they should consider teaching teamwork explicitly. Our findings suggest students may not significantly improve their teamwork knowledge and skills simply participating on a team to complete a class project. Instead, an instructor may need to overtly inform students that acquisition of teamwork skills is a learning objective, and subsequently provide explicit instruction to support students' acquisition, practice, and recognition of teamwork skills during the learning experience. This may be difficult in courses where technical content is the primary focus and consumes most of the instructional time. A practical suggestion may be for technical content course instructors to partner with leadership and communications instructors to identify ways to integrate interpersonal skill instruction into pre-existing coursework and assignments like team projects.

The AgLead students in this sample scored significantly higher in psychological safety, group potency, and satisfaction than the students in AgEng at the beginning of the semester. One potential explanation for this difference is AgLead students are exposed more frequently to interpersonal leadership education and may have initially been more comfortable in group settings and the prospect of completing a group project. It is also plausible AgLead students were familiar with more of their classmates from previous coursework than AgEng students. Although there were significant differences between the groups on the TEQ in satisfaction, psychological safety, and group potency at the beginning of the semester, these differences were mitigated over the course of the semester. Given that AgEng students only reported a significant increase in psychological safety over the course of the semester and AgLead students reported no significant differences on any of the group-level outcomes, additional research is necessary to understand the nuances of students' understanding of and experience with group-level outcomes.

The major implications of this research are two-fold. First, if instructors wish to increase students' teamwork knowledge and skill, they should consider explicitly and overtly teaching teamwork. Secondly, when considering how to teach teamwork, instructors should take note that experiencing the highest levels of group development, and thus, peak performance, likely takes longer than a traditional 16-week semester. Although student teams are capable of developing processes and relationships to the extent required to complete a project within a semester, they may not be experiencing authentic team development. Therefore, instructors should consider integrating intentional direct instruction on group development, with an emphasis on navigating the initial stages experientially. This can set more realistic expectations for students as they move into the workforce and begin working on teams. Moreover, instructors should consider incorporating guided reflection for students to consider what group development they have experienced, what development they have been unable to achieve, and why.

Future research should replicate this study comparing courses with similar content. We explored student outcomes in two different courses to better understand the nature of explicit teamwork instruction

and covert teamwork instruction through the integration of team projects. A fundamental follow-up study would compare student learning outcomes in similar technical content courses that integrate overt and covert teamwork instruction. In addition, we recommend investigating instructors' willingness and ability to integrate interpersonal skill development into technical content courses, along with effective pedagogies to accomplish such. Furthermore, qualitative research may help illuminate students' lack of self-perceived teamwork skill development despite successfully completing a team project. Finally, other strategies for teaching teamwork besides traditional team projects should be investigated.

Employers continue to seek college graduates with interpersonal skills, including leadership and the ability to work in teams. Whether engaging students in teamwork- and leadership-focused coursework or integrating teamwork and leadership instruction into technical content coursework, agricultural education must continue to improve our graduates' interpersonal skills for success in the workforce.

References

Anderson, C. M., Martin, M. M., & Riddle, B. L. (2001). Small group relational satisfaction scale: Development, reliability and validity. *Communication Studies*, *52*(3), 220–233. https://doi.org/10.1080/10510970109388555

Anicich, E. M., Lee, M. Y., & Sanchez Celi, J. P. (2024, March). The challenges of becoming a less hierarchical company. *Harvard Business Review.* https://hbr.org/2024/03/the-challenges-of-becoming-a-less-hierarchical-company

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122–147. https://doi.org/10.1037/0003-066X.37.2.122

Britton, E., Simper, N., Leger, A., & Stephenson, J. (2017). Assessing teamwork in undergraduate education: A measurement tool to evaluate individual teamwork skills. *Assessment and Evaluation in Higher Education, 42*(3), 378–397. https://doi.org/10.1080/02602938.2015.1116497

Chamorro-Premuzic, T., & Frankiewicz, B. (2019, January). Does higher education still prepare people for jobs? *Harvard Business Review*. https://hbr.org/2019/01/does-higher-education-still-prepare-people-for-jobs

Cletzer, D. A., Mott, R. L., Simonsen, J. C., Tummons, J. D., Peckman, J. Y., & Preston, K. (2022). Agricultural leadership: A national portrait of undergraduate course. *Journal of Agricultural Education, 63*(1), 165–181. https://doi.org/10.5032/jae.2022.01165

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Routledge Academic.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management, 23*, 239–290. https://doi.org/10.1177/014920639702300303

Dechant, K., Marsick, V. J., & Kasl, E. (1993). Towards a model of team learning. *Studies in Continuing Education, 15(*1), 1–14. https://doi.org/10.1080/0158037930150101

Decuyper, S., Dochy, F., & Van den Bossche, P. (2010). Grasping the dynamic complexity of team learning: An integrative model for effective team learning in organisations. *Educational Research Review, 5*(2), 111–133. https://doi.org/10.1016/j.edurev.2010.02.002

De Dreu, C. K., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology, 88*(4), 741. https://doi.org/10.1037/0021-9010.88.4.741

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly, 44(*2), 350–383. https://doi.org/10.2307%2F2666999

Gully, S. M., Incalcaterra, K. A., Johi, A., & Beaubien, J. M. (2002). A meta-analysis of team efficacy, potency and performance: Interdependence and level of analysis as moderators of observed relationships. *Journal of Applied Psychology, 87*(5), 819–832. https://doi.org/10.1037/0021-9010.87.5.819

Hart Research Associates. (2016). Falling Short? College learning and career success. *NACTA Journal, 60*(1a), 1–6. https://www.nactateachers.org/index.php/vol-60-1a-may-2016/2394-falling-short-college-learning-and-career-success

Hastie, C. R. (2018). 'TeamUP': An approach to developing teamwork skills in undergraduate midwifery students. *Midwifery, 58*, 93–95. https://doi.org/10.1016/j.midw.2017.12.026

Hendrix, R., & Morrison, C. C. (2018). Student perceptions of workforce readiness in agriculture. *Journal of Agricultural Education, 59*(3), 213–228. https://doi.org/10.5032/jae.2018.03213

Hobson, C. J., Strupeck, D., Griffin, A., Szostek, J., & Rominger, A. S. (2014). Teaching MBA students teamwork and team leadership skills: Am empirical evaluation of a classroom educational program. *American Journal of Business Education, 7*(3), 191–212. https://doi.org/10.19030/ajbe.v7i3.8629

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology, 56*, 517–543. https://doi.org/10.1146/annurev.psych.56.091103.070250

Johnson, S. D., Suriya, C., Yoon, S. W., Berrett, J. V., & La Fleur, J. (2002). Team development and group processes of virtual learning teams. *Computers & Education, 39*(4), 379–393. https://doi.org/10.1016/S0360-1315(02)00074-X

Kliegl, J. A., & Weaver, K. D. (2014). Teaching teamwork through coteaching in the business classroom. *Business and Professional Communication Quarterly, 77*(2), 204–216. https://doi.org/10.1177/1080569913507596

Lamm, K. W., Powell, a. N., Randall, N., Nguyen, N. P., & Lamm, A. J. (2022). Undergraduate project team satisfaction: Analysis of a theoretically derived structural model. *Journal of Agricultural Education, 61*(20), 307–323. https://doi.org/10.5032/jae.2020.02307

Layne, D. R., Kidwell, K. K., & Carney, E. (2019). Transformative learning for senior-level students in the agricultural and food systems interdisciplinary program at Washington State University. *NACTA Journal, 63*(1), 53–59. https://nactateachers.org/index.php/vol-63-1-mar-2019/2817-transformative-learning

Levi, D. (2014). *Group Dynamics for Teams* (4th ed.). Sage Publications, Inc.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *The Academy of Management Review, 26*(3), 356–376. https://doi.org/10.5465/amr.2001.4845785

Mathieu, J., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future. *Journal of management, 34*(3), 410–476. https://doi.org/10.1177%2F0149206308316061

Merriam, S. B., & Baumgartner, L. M. (2020). *Learning in adulthood: A comprehensive guide*. John Wiley and Sons.

Morgeson, F. P., DeRue, D. S., & Karam, E. P. (2010). Leadership in teams: A functional approach to understanding leadership structures and processes. *Journal of Management, 36*(10), 5–39. https://doi.org/10.1177/0149206309347376

Nellen, L. C., Gijselaers, W. H., & Grohnert, T. (2020). A meta-analytic literature review on organization-level drivers of team learning. *Human Resource Development Review, 19*(2), 152–182. https://doi.org/10.1177%2F1534484319894756

Orsini, J., Greenhaw, L.L., Coleman, B.M., Stone, W.A., & Bunch, J.C. (2021). Experiential learning style grouping impact on student outcomes in team leadership coursework. *Small Group Research 53*(3), 366–399. https://doi.org/10.1177/10464964211023558

Parratt, J. A., Fahy, K. M., Hutchinson, M., Lohmann, G., Hastie, C. R., Chaseling, M., & O'Brien, K. (2016). Expert validation of a teamwork assessment rubric: A modified Delphi study. *Nurse Education Today, 36,* 77–85. https://doi.org/10.1016/j.nedt.2015.07.023

Raes, E., Kyndt, E., Decuyper, S., Van den Bossche, P., & Dochy, F. (2015). An exploratory study of group development and team learning. *Human Resource Development Quarterly, 26*(1), 5–30. https://doi.org/10.1002/hrdq.21201

Riebe, L., Reopen, D., Santarelli, B., & Marchioro, G. (2010). Teamwork: Effectively teaching an employability skill. *Education + Training, 52*(6/7), 528–539. https://doi.org/10.1108/00400911011068478

Senge, P. (1990). *The fifth discipline: The art and practice of the learning organization*. Currency Doubleday.

Shea, G. P., & Guzzo, R. A. (1987). Group effectiveness: What really matters? *Sloan Management Review, 28*, 25–31.

Shelton, P. M., Waite, A. M., & Makela, C. J. (2010). Highly effective teams: A relational analysis of group potency and perceived organizational support. *Advances in Developing Human Resources, 12*, 93–116. https://doi.org/10.1177/1523422310365665

Sundström, E., Mcintyre, M., Halfhill, T., & Richards, H. (2000). Work groups: From the Hawthorne studies to work teams of the 1990s and beyond. *Group Dynamics: Theory, Research, and Practice, 4(*1), 44–67. https://doi.org/10.1037//1089-2699.4.1.44

Sinche, M., Layton, R. L., Brandt, P. D., O'Connell, A. B., Hall, J. D., Freeman, A. M., Harrell, J. R., Cook, J. G., & Brennwald, P. J. (2017). An evidence-based evaluation of transferrable skills and job satisfaction for science PhDs. *PLoS ONE, 12*(9), e0186023. https://doi.org/10.1371/journal.pone.0185023

Tuckman, B., & Jensen, M. (1977). Stages of small group development revisited. *Group and Organizational Studies, 2*(4), 419–427. https://doi.org/10.1177/105960117700200404

Van den Bossche, P., Gijselaers, W. H., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments: Team learning beliefs and behaviors. *Small group research, 37(*5), 490–521. https://doi.org/10.1177%2F1046496406292938

Varela, O., & Mead, E. (2018). Teamwork skill assessment: Development of a measure for academia. *Journal of Education for Business, 93*(4), 172–182. https://doi.org/10.1080/08832323.2018.1433124

Vaughan, B., Yoxall, J., & Grace, S. (2019). Peer assessment of teamwork in group projects: Evaluation of a rubric. *Issues in Educational Research, 29*(3), 961–978. https://www.researchgate.net/publication/334450628_Peer_assessment_of_teamwork_in_group_projects_Evaluation_of_a_rubric

Webb, J. D., Miller, N. G., & McNew, R. W. (2004). Training: Promoting effective teamwork in the college classroom. *NACTA Journal, 48*(4)*,* 39–44. https://nactateachers.org/index.php/vol-48-num-4-december-2004-sp-950943187/429-training-promoting-effective-teamwork-in-the-college-classroom

Weinstein, J., Morton, L., Taras, H., & Reznik, V. (2013). Teaching teamwork to law students. *Journal of Legal Education, 63*(1), 36–64. https://www.jstor.org/stable/42894326

Wheelan, S. A. (2005). *Group processes: A developmental perspective* (2nd ed.). Pearson.

Wheelan, S. A. (2009). Group size, group development, and group productivity. *Small Group Research, 40*(2), 247–262. https://doi.org/10.1177%2F1046496408328703

Wheelan, S. A., Akerlund, M., & Jacobsson, C. (2025). *Creating effective teams: A guide for members and leaders* (7th ed.)*.* Sage.

Wilson, J. M., Goodman, P. S., & Cronin, M. A. (2007). Group learning. *Academy of Management Review, 32*(4), 1041–1059. https://doi.org/10.5465/amr.2007.26585724

Yilmaz, R., Yilmaz, F. G. K., & Keser, H. (2020). Vertical versus shared e-leadership approach in online project-based learning: a comparison of self-regulated learning skills, motivation and group collaboration. *Journal of Computing in Higher Education, 32*, 628–654. https://doi.org/10.1007/s12528-020-09250-2

Zaccaro, S. J., Rittman, A. L., & Marks, M. A. (2001). Team Leadership. *The Leadership Quarterly, 12*, 451–483. https://doi.org/10.1016/S1048-9843(01)00093-5