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Teamwork Training for Engineering Students

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TEAMWORK TRAINING FOR ENGINEERING STUDENTS

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ABSTRACT

The ability to work effectively in teams is one of the most highly sought-after capabilities in organizations today. The Accreditation Board of Engineering and Technology (ABET) now requires colleges and universities develop teamwork skills in graduates. Evidence indicates that students and instructors view the teamwork graduate attribute as important for career success. However, despite the push from accreditation boards to increase the focus on teamwork skill development, industry continues to express that there is a gap in student capability. In an attempt to address this need, instructors are increasingly organizing course work around teamwork activities. However, students and faculty often lack evidence-based, scientifically derived tools, training, and technology to shape these teamwork skills. This research assesses the effectiveness of a teamwork training program design on building individual student competencies associated with team effectiveness to better enable engineering programs to meet the teamwork objective required for ABET accreditation. Additionally, this research assesses if the delivery of the content in terms of timing (i.e., all at once vs. spread out in smaller chunks of time) impacts training effectiveness. The students reacted favorably to the training, the training increased individual team role knowledge by 10 percent, the training did not impact individual behavior, and the impact on team behavior was inconclusive. Furthermore, completing the training all at once or completing the training over multiple sessions did not have an impact on training effectiveness.

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CHAPTER ONE

INTRODUCTION

Over the past few decades, there has been increased demand for outcomes-based accreditation of engineering programs in the United States (ABET, 2019). To create a curriculum in which students can learn and be assessed in alignment with these outcomes, there has been an industry-wide push towards creating alternate learning environments that model real-world practice. This includes a shift from a lecture-based approach to teaching to one that incorporates cooperative learning situations in which students work together on structured activities in groups. A key facet of success for these environments is incorporating team-based learning situations in which students work collaboratively to solve a problem in a manner that models industry practice.

However, despite the requirement from accreditation boards to include developing the capability to work in teams, industry continues to express that there is a gap in student capability. The ability to work effectively in teams is one of the most highly sought-after capabilities, however companies report that it is one of the areas in which their newly hired graduates are least competent (Felder, 2012).

One of the drivers for this mismatch between industry needs and student skill development may be due to a lack of clearly defined and meaningful teamwork skill development opportunities during undergraduate education. Design teams and group projects have frequently been used to satisfy these calls for more activities in the engineering classroom. Design teams have intensive interdependence (Borrego, Karlin, McNair, & Beddoes, 2013), students have a personal responsibility to complete the team's deliverables and work on projects that require interpersonal skills to navigate their complexity (Hyman, 2003). However, while these projects require interpersonal skills, without a structured framework clearly mapping teamwork skill learning objectives to group and team course activities, students are likely to gain little clarity as to whether they are working together well or not. Collaborative learning has shown to improve information acquisition, but this learning will not have the space to occur if students are distracted by team dysfunction (Johnson, Johnson, & Smith, 1998). The conditions for group learning in higher education settings rarely meet the standards advocated in the cooperative learning literature, often due to instructors having limited knowledge of empirically backed tools and training on collaborative learning and difficulty transferring available information into practice (De Hei, Strijbos, Sjoer, & Admiraal, 2015). Few instructors have either extensive experience working in groups themselves or formal training about how to improve teamwork skills. As a result, many well-intentioned instructors assign group projects without providing students the information and guidance necessary for the development of teamwork skills (Colbeck, Campbell, & Bjorklund, 2000). Instruction on how to work effectively as a team is needed to ensure that students can leverage the full benefits of cooperative learning and team-based learning in their learning environments and ensure they do not develop negative perceptions of team-based work (Lingard, 2010).

The current research effort aims to investigate how the design, content, and delivery of targeted teamwork training may be used to better enable engineering programs to meet that objective. As this study is being conducted in the context of engineering education, it addresses one of the seven student outcomes required for ABET accreditation: "an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives"(ABET, 2019 p. 6). Driven by the current state of the science in the broader team development intervention literature, this research will explore the impact of exposing students to tools and resources focused on developing psychological safety and conflict management, two critical foundation blocks that lead to effective teamwork (Salas, et al., 2015). Furthermore, this study approaches developing students' capability to work in teams at an individual level, focusing on developing the behavioral competencies necessary to work effectively as a member of a team that can be transferred to other work contexts (Salas, Cooke, & Rosen, 2008).

This research will assess the effectiveness of a teamwork training program design, content, and delivery on building individual student competencies associated with team effectiveness to better enable engineering programs to meet the teamwork objective required for ABET accreditation. This training is designed to be performed in the students' design teams/project teams as there are interactive and discussion components required for learning. Participants will be assigned to either the experimental group or the control group. Within the experimental group, students will be assigned to experimental condition one or experimental condition two. The training content for experimental condition one and two is the exact same. Participants in experimental condition one will complete all training content in one session, while those in experimental condition two will complete all training content in two separate, smaller chunks. The first chunk of training will cover psychological safety and the second chunk will cover conflict. It is expected that the training will improve student competencies associated with team effectiveness and training over multiple sessions will be the most effective.

A recent study found fine-grained distributed (i.e., content split into small chunks) and medium-grained distributed (i.e., content split into medium chunks) learning lead to better achievement than blocked presentation (i.e., content all at once) (Kapp, Proske, Narciss, & Körndle, 2015). In addition to assessing the overall effectiveness of the training program, this study will test the impact of content delivery, in terms of training in small chunks of content or all the content at once, on training effectiveness.

Developing these behavioral competencies in the individual instead of the team as a whole is necessary as students change project teams across courses and need to be able to transfer these skills to their work after graduation. These behaviors are the individual building blocks of team-effectiveness; the more competent a student is, the stronger their foundation, and more effective team members can build a stronger and more proficient team. The present study aims to determine (1) how effective the training content is for improving students' learning and behaviors regarding teamwork; and (2) if the delivery of the content in terms of timing (i.e., all at once vs. spread out in smaller chunks of time) impacts training effectiveness.

CHAPTER TWO

LITERATURE REVIEW AND HYPOTHESES

Teamwork in Engineering

Team-based projects have become a common teaching practice in engineering courses to simulate real-world environments while also meeting ABET accreditation requirements for the development of teamwork skills. Within design courses, team-based projects allow a team of students to engage in and solve problems that are technically more complex than problems a student would be able to tackle working individually. Students are typically introduced to teamwork in their undergraduate engineering program, usually in the form of a design course. Design-team-based projects are both learning environments and production environments. They encourage each student to develop a greater understanding of the concepts, processes, and the subject of their design work (learning) while producing a design that sufficiently meets the requirements (production).

Teamwork in the undergraduate engineering experience primarily occurs in self-managed teams. A self-managed team determines how to achieve their goals, how to manage their workflow, and how to make decisions together without external influence (Wageman, 1997). Self-managed teams have been used in situations where interpersonal interaction, communication and creativity are encouraged (McNair, Newswander, Boden, & Borrego, 2011), which is applicable for engineering design work. However, allowing students to define how their teams operate is not without concern, as the development of well-designed team norms, which define how the team members will behave, is necessary for success (Wageman, 1997). Because of this, it is critical that students are trained on how to work effectively in teams. However, many times students are assigned team projects with limited or no training about how to work in teams (Snyder, 2009). Students and faculty often lack evidence-based, scientifically derived tools, training, and technology to shape these teamwork skills.

This study will focus on evaluating the effectiveness of two teamwork training modules tailored to improve individual student teamwork competencies and determine if the delivery of the content in terms of timing impacts training effectiveness. It is important to note that this research focuses on individual students, not teams. This objective was motivated by two reasons. First, the ABET student outcome accreditation requirement related to teamwork focuses on building individual student competency. Second, students need to develop teamwork behaviors that they can use beyond the team in which they receive the teamwork skills training. As a result, the teamwork training modules center on building individual students' competency as team members, rather than simply focusing on building effective teams. The goal is for students to develop individual, transferable teamwork behaviors that will extend beyond the project team in which they used.

Psychological Safety

Psychological safety is defined as a shared belief held by members of a team that the team is safe for interpersonal risk taking (Edmondson, 1999). From a practical perspective, psychological safety is important given the growth of knowledge economies and the increased use of teamwork. Both of these trends have created work relationships in which employees are expected to integrate perspectives, share information and ideas, and collaborate to achieve shared goals. This includes the need to ask questions, seek help, and tolerate mistakes in the face of uncertainty while team members and other colleagues watch. In the absence of psychological safety, interpersonal risk is a powerful force that makes effective collaboration less likely to occur, particularly when the work is characterized by uncertainty and complexity (Edmondson & Lei, 2014).

Students in design teams need to be able to engage with each other to debate and discuss their respective understandings of the design project and different design concepts as well as to construct a shared meaning to create a coherent product. Students in these types of projects cannot simply subdivide the projects into smaller individual, independent tasks that can be reassembled into a coherent whole, as that is not the way in which design happens (Hyman, 2003). Design engineers working on product development have been observed to spend approximately 40% of their time in 'socially collaborative work' such as meeting with their team or clients, and discussion or developing ideas (Robinson, 2012). Psychological safety is critical in this intensively interdependent team environment and throughout the engineering design process.

An important practical implication from the literature on psychological safety is that this positive interpersonal climate, which is conducive to learning and performance under uncertainty, does not emerge naturally (Edmondson & Lei, 2014). This makes training students on how to foster psychological safety in their teams more crucial for success in classroom teams and beyond. Even when employees are in an organization with a strong culture, their perceptions of feeling safe to speak up, ask for help, or provide feedback tend to vary from department to department, and team to team (Edmondson 2003). Some of this variance can be attributed to the individual differences of direct managers and supervisors, whose different styles and behaviors convey very different messages about the consequences of taking interpersonal risks associated with willingly contributing (Edmondson, 1996; Edmondson, 2003).

A climate of psychological safety is necessary to mitigate interpersonal risks and make collaboration more likely, particularly in the face of uncertainty, complexity, and interdependence. Managers should recognize the importance of communication and deliberate interventions to build and maintain psychological safety. Employees can help through their willingness to speak up, ask questions, and challenge the status quo. Managers must learn to value employees who engage in those behaviors, even though they may go against their natural instincts to prefer employee silence and agreement with the status quo.

Conflict

Conflict is a common occurrence and teams are bound to experience conflict during their life cycle. Therefore, conflict can be considered a fundamental aspect of working with others. Conflict can be defined as perceived incompatibilities in the interests, beliefs, or views held by one or more team members (Jehn, 1995). Conflict is particularly problematic in team settings, as it can lead to errors and breakdowns in performance (Salas, Cooke, & Rosen, 2008). The impact of conflict on performance is further magnified by the complexity of the team's task (De Dreu & Weingart, 2003), an important consideration in engineering design teams. Conflict can interfere with goal attainment, leading to increased stress and a potentially volatile or otherwise unhealthy situation.

Conflict management can be defined as the practice of identifying and handling conflict in a sensible, fair, and efficient manner (Behfar, Peterson, Mannix, & Trochim, 2008). Properly managed conflict can lead to an increased understanding between parties, which in turn leads to improved methods of functioning. Conflict management strategies have been found to alleviate the negative impacts of conflict, particularly its effects on team cohesion (Tekleab, Quigley, & Tesluk, 2009). Recent literature supports this claim, as teams that manage conflict directly are better able to create a healthy, open, and constructive environment that enhances team performance (Cameron, 2000; Campbell & Dunnette, 1968; Montoya-Weiss, Massey, & Song, 2001).

There is no best style for managing conflict in every circumstance, as it depends on individual differences, dispositions, and the context of the situation (Rahim & Bonoma, 1979). It is critical to train students on conflict so they gain greater awareness about conflict management strategies and how those strategies may influence interactions with others. Training students on how to create norms for handling conflict, as well as assessing and effectively managing conflict on a regular basis, is a critical consideration for teamwork across student project teams and in organizational contexts.

Evaluating Training Effectiveness

Training effectiveness will be evaluated using the Kirkpatrick Model. Kirkpatrick's model of training evaluation criteria has had widespread, enduring popularity and has been used for decades across many industries. The model centers on four levels of training evaluation: reaction, learning, behavior, and results (Kirkpatrick & Kirkpatrick, 2012). Reaction is defined as the degree to which participants find the training favorable, engaging, and relevant. Learning is defined as the degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training. Behavior is defined as the degree to which participants apply what they learned during training. Finally, results are defined as the degree to which targeted outcomes occur as a result of the training (Kirkpatrick & Kirkpatrick, 2012).

The Kirkpatrick framework has several theoretical and practical shortcomings that have been well articulated elsewhere (Alliger & Janak, 1989; Holton, 1996; Kraiger, 2002) and will not be discussed in detail here. Although the Kirkpatrick hierarchy has clear limitations, using it for training evaluation does contribute information which allows for well-grounded decisions to be made about the training, including any necessary modifications. Nonetheless, Kirkpatrick's framework remains the basis for much of the evaluation efforts in organizations today and remains a valid measure of training effectiveness. This research will use student reactions to the training to measure reactions, a team role knowledge measure for learning, peer feedback and team dynamics measures for behaviors, and individual project grades to measure results. A summary table detailing the Kirkpatrick model evaluation level, measure, and experimental design is available in Appendix A.

Reaction: Student reaction to training

Evaluating reactions is essentially measuring satisfaction with the training. For the training to be effective it is essential that students react favorably to it, otherwise, students will not be motivated to learn. Furthermore, students will tell others of their reactions to the training, so it is imperative it is viewed favorably. Measuring reactions is important for several reasons. First, it provides valuable feedback that helps evaluate the training modules as well as comments and suggestions for improving the training in the future. Next, it shows trainees that the training is there to help them improve and that their feedback is necessary to determine how effective the training is. Finally, reactions give quantitative information that can be provided to stakeholders and can be used to establish standards of performance for future programs. Positive reactions to training are associated with greater motivation, greater learning, and transfer of training back on the job (Baldwin, Magjuka, & Loher, 1991; Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). Reactions to the training were only be collected from the experimental group. It is hypothesized (H1a) students who complete the teamwork training will react favorably to the training and (H1b) students who complete the training content in two separate sessions will have more positive reactions to the training compared to students who complete all training content in one session.

Learning: Team Role Knowledge

One way to understand the contributions individuals make to teams is by considering the roles members play in executing critical team functions (Stewart, Fulmer, & Barrick, 2005; Stewart, Manz, & Sims, 1999). Roles are necessary for effective internal execution of the team's work, effective management of the team's relationship with its environment, and the preservation of team vitality through meeting the social needs of its members (Hackman, 1987; McGrath, 1984; Sundstrom, De Meuse, & Futrell, 1990).

One of the main ways in which team role knowledge is likely to influence role performance is by increasing team members' role repertoires. A role repertoire represents the sum total of role behaviors a person is able to display (Cameron, 1950; Sarbin & Allen, 1968). Having a broad role repertoire, in turn, allows team members to adapt their role in response to changing situations (Ginnett, 1990; McIntyre & Salas, 1995; Parker, 1996).

Role adaptability is particularly important for situations in which environmental and social cues are relatively ambiguous. Teamwork is often assigned to the team in its entirety, often without clear delineation as to who should perform each task. This creates ambiguity around what each team member is supposed to do. Every team member usually is given some responsibility in a team environment. This can create uncertainty around expectations, introduce a greater possibility of role conflict, and increase the probability that team members will need to perform multiple roles to accommodate these expectations.

Knowledge concerning team roles, and the situations governing their use, is critical to effective team member performance. This study will use the Team Role Test, a situational judgment test (SJT) designed to measure team role knowledge and the contingencies surrounding their appropriate use in team situations, to measure learning

(Mumford, Van Iddekinge, Morgeson, & Campion, 2008). Team members who possess the knowledge necessary to perceive changes in role requirements, and adapt their role to those requirements, are more effective team members than those who do not possess this type of knowledge (Mumford, Van Iddekinge, Morgeson, & Campion, 2008). The Team Role Test was administered to the experimental and control group in a pre-test/post-test design. It is hypothesized (H2a) students who complete teamwork training will show greater improvement on measures of learning regarding teamwork when compared to students who do not complete training, and (H2b) students who complete the training content in two separate sessions will show greater improvement on measures of learning regarding teamwork when compared to students who complete all training content in one session.

Behavior: Peer Feedback and Team Dynamics

Behavioral measures evaluate how much transfer of knowledge, skills, and abilities occurred due to training. A popular way to measure behavior in teams is with peer assessments. Within engineering design teams, a student's team members, or peers, are in a better position to provide assessments of a student's team-member effectiveness (McGourty, 2000). Students can leverage a broader context for the feedback because most teamwork in engineering team projects happens outside of instructor or teaching assistant supervised work time. This study will evaluate both individual behaviors and team behaviors.

To measure individual behaviors, team members will provide anonymous feedback on five individual team behavioral competencies that are associated with team effectiveness; commitment to the team's work, communicating with team members, having a strong foundation of knowledge, skills and abilities, emphasizing high standards, and keeping the team on track (Donia, O'Neill, & Brutus, 2018). Peer feedback surveys were administered to the experimental and control group.

The training outlined in this study should improve students' individual teamwork competencies, which in turn will lead to more effective teams (Salas, Cooke, & Rosen, 2008). To assess team behaviors, this study will utilize an empirically valid team dynamics measure that will assess how well the team is functioning in four key areas: communication, adaptability, relationships, and education (O'Neill, Deacon, Gibbard, Larson, Hoffart, Smith, & Donia, 2018). Communication measures how well the team creates a cooperative environment, ensures role clarity, and develops a clear course of action for teamwork. Adaptability assesses how well the team coordinates efforts in response to changing task demands, monitors team members' progress, and provides backup. Relationships measures how well the team reduces interpersonal conflicts and arguments regarding how to accomplish work and focuses on building trust and a safe place for sharing. Finally, education assesses how well the team learns from other team members and provides each other with constructive feedback. The team dynamics measure was administered to the experimental and control group. It is hypothesized (H3a) Students who complete teamwork training will show greater improvement on measures of individual teamwork behaviors when compared to students who do not complete training, and (H3b) students who complete the training content in two separate sessions will show greater improvement on measures of individual teamwork behaviors regarding teamwork when compared to students who complete all training content in one session. (H4a) Students who complete teamwork training will show greater improvement on measures of team behaviors when compared to students who do not complete training, and (H4b) students who complete the training content in two separate sessions will show greater improvement on measures of team behaviors when compared to students who complete all training content in one session.

Result: Individual Grade

Results will be evaluated by using the individual final grades on the project. A major part of the individual grade is determined by this assignment, and individual student grades indicate the degree to which the student can produce a design that meets the requirements. This is an important objective measure that provides insight into how the individual contributed to team success. Final grades will be collected from the experimental and control group at the end of the semester. It is hypothesized (H5a) Students who complete the teamwork training will have higher final grades when compared to students who do not complete training, and (H5b) students who complete the training content in two separate sessions will have higher final grades compared to students who complete all training content in one session.

Training Design Considerations

Training design considerations for teamwork skill development were driven by the current state of the science in the broader team development intervention literature, and will explore the impact of exposing students to tools and resources focused on developing psychological safety and conflict management, two critical foundation blocks that lead to effective teamwork (Salas, et al., 2015). Training specific teamwork competencies, such as conflict management and psychological safety, have been shown to be more effective at improving teamwork skills than training generic teamwork skills (Salas, et al., 2014). Furthermore, this study approaches developing students' capability to work in teams at an individual level, focusing on developing the behavioral competencies necessary to work effectively as a member of a team that can be transferred to other work contexts (Salas, Cooke, & Rosen, 2008).

Based on a review of relevant literature it appears that many strategies are available to enhance a training program for improving teamwork competencies. This training will utilize the elements of providing information, demonstrating behaviors, and allowing students to practice identified as best practices in the training literature (Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012). After identifying these training strategies this Program of Instruction (POI) was developed. The content and training delivery methods for this training program are detailed in this POI and each module will be discussed in more detail below.

Program of Instruction (POI) Overview

A description of the learning objectives and instructional activities used in the POI are summarized below. The specific training delivery methods or tools can be grouped into three main categories: information-based methods, demonstration-based methods, and practice-based methods. By moving from information-based, to demonstration-based, to practice-based methods, students will progress from less active (i.e., passively acquiring general knowledge of the topic via text and narration) to more active learning (i.e., practice in scenario-based training). Due to the complexity and likely unfamiliarity of the content to be trained, it is necessary to provide students with some conceptual framework of the material via information-based methods before they are put into practice-based activities. Without an appropriate baseline understanding of the material to guide behavior in practice scenarios, high-level learning outcomes are not achievable. This training is designed to be performed in the students' design teams/project teams as there are interactive and discussion components required for learning.

Module 1: Psychological Safety

This module focuses on introducing the concept of psychological safety, provides tools to diagnose a team's psychological safety, and ways to foster psychological safety within a team. Examples of teams with good and bad psychological safety will be provided. Students are allowed to practice diagnosing a previous team's psychological safety and ways they will foster psychological safety on their current teams using the information and demonstrations provided. Additionally, a series of text-based vignettes allow students to identify and discuss ways in which psychologically safe behaviors could have improved a realistic scenario.

Module 2: Conflict

The conflict module focuses on understanding why effective conflict management is critical in teams and provides best practices to address conflict in teams. This module introduces different conflict management styles and students will understand the objectives of the different styles as well as in which situations they are most useful.

Students are given the opportunity to discuss in small groups why some conflict management styles are better in certain situations than others. Students apply the knowledge learned in this module to analyze a previous conflict. And finally, a series of text-based vignettes allow students to identify and discuss ways they would respond to conflicts in a realistic scenario. The POI can be seen in detail in Appendix B.

Hypotheses

The present study aims to determine (1) how effective the training content is for improving students' learning and behaviors regarding teamwork; and (2) if the delivery of the content in terms of timing (i.e., all at once vs. spread out in smaller chunks of time) impacts training effectiveness. It is hypothesized (H1a) students who complete the teamwork training will react favorably to the training and (H1b) students who complete the training content in two separate sessions will have more positive reactions to the training compared to students who complete all training content in one session.

(H2a) Students who complete teamwork training will show greater improvement on measures of learning regarding teamwork when compared to students who do not complete training, and (H2b) students who complete the training content in two separate sessions will show greater improvement on measures of learning regarding teamwork when compared to students who complete all training content in one session.

(H3a) Students who complete teamwork training will show greater improvement on measures of individual teamwork behaviors when compared to students who do not complete training, and (H3b) students who complete the training content in two separate sessions will show greater improvement on measures of individual teamwork behaviors regarding teamwork when compared to students who complete all training content in one session.

(H4a) Students who complete teamwork training will show greater improvement on measures of team behaviors when compared to students who do not complete training, and (H4b) students who complete the training content in two separate sessions will show greater improvement on measures of team behaviors when compared to students who complete all training content in one session.

(H5a) Students who complete the teamwork training will have higher final grades when compared to students who do not complete training, and (H5b) students who complete the training content in two separate sessions will have higher final grades compared to students who complete all training content in one session.

Due to unforeseen delays in the data collection process caused by the COVID-19 pandemic and Graduate School deadlines, hypotheses 3b, 4b, 5a, and 5b will not be addressed in this manuscript.

CHAPTER THREE

METHODOLOGY

Overview

This study assesses the effectiveness of a teamwork training program design, content, and delivery on building individual student competencies associated with team effectiveness to better enable engineering programs to meet the teamwork objective required for ABET accreditation. The training was completed in the students' design teams/project teams as there are interactive and discussion components required for learning. Pretest measures were administered to all participants. Participants in the experimental group either completed all training content in one session or completed all training content in two separate sessions. Participants in the control group did not complete the training. Posttest measures were administered to all participants seven weeks from the pretest measures. Figure 1 presents a timeline of events.

Participants

Participants were engineering students from Clemson University who are working in teams or groups. Recruitment was from two specific courses within the Civil Engineering department, a senior level undergraduate course and a graduate level course. Course homework credit was offered to increase participation. Between the two courses there was a possible 65 participants, 37 from the undergraduate course and 28 from the graduate course. Participation varied among the measures, from full participation to roughly fifty percent participation. The number of total participants for each measure can be seen in Table 1. Demographic information was not collected from participants.

Procedure

The original plan was for true random assignment of groups within the same course, however, due to extenuating circumstances that was unable to occur. The senior level undergraduate civil engineering course served as the experimental group and had a total of 37 possible participants. This course had two lab sections. Lab section one served as experimental condition one and completed training all in one session. Lab section two served as experimental condition two and completed the training in two separate sessions. Lab section one and two contained a possible 16 and 21 students respectively. The graduate level civil engineering course served as the control group and did not complete the training. The control group had 28 possible participants.

Pretest measures were administered approximately four weeks into the semester. This was done to ensure that team members were sufficiently familiar with each other and the team tasks. One week after completion of the pretest measures experimental condition one participants completed the psychological safety and conflict training modules all in one session with their teams. At the same time, participants in experimental condition two completed the psychological safety training module in their teams. One week after completion of the first module, participants in experimental condition two completed the conflict module in their teams. A knowledge check quiz for each module was administered to confirm the participants completed the training. Posttest measures were collected seven weeks after pretest measures were administered. This allowed participants time to apply the knowledge from the training in their team activities.

Measures

Training effectiveness was evaluated using the Kirkpatrick Model. The model centers on four levels of training evaluation: reaction, learning, behavior, and results (Kirkpatrick & Kirkpatrick, 2012).

Reaction: Reaction to training

Student reactions to the training were measured using a three-item scale (Kirkpatrick & Kirkpatrick, 2012). One item measured overall training effectiveness on a 5-point Likert-type scale whereby 1 = very ineffective and 5 = very effective. The additional items measured what participants liked about the training and what they would improve about the training. Responses were reviewed and common themes were identified. See Appendix C for details.

Learning: Team role knowledge

Team role knowledge was measured using a modified version of the Team Role Test, a situational judgment test that measures team role knowledge (Mumford et al., 2008). The Team Role Test consists of 10 scenarios with 10 possible ways to respond to each scenario. The modified version used 50 items. For this study the pretest used responses 1 through 5, while the posttest used responses 6 through 10. This was done to reduce survey fatigue and reduce the possibility of the "practice effect" of taking the same exact test twice in a relatively short time period. Respondents rated the effectiveness of each action on a 5-point Likert-type scale whereby 1 = a very ineffective way to handle the situation and 5 = a very effective way to handle the situation. Thus, each respondent made 5 ratings per scenario. To derive scores for knowledge of team roles, respondents' ratings of actions that reflected role-inconsistent behaviors (which should receive low effectiveness ratings) were reverse-coded. For instance, ratings of "1" yielded a high score of "5." Then, the mean effectiveness rating across all the items was calculated such that higher means indicated higher role knowledge (i.e., rating role-consistent behaviors as effective and role- inconsistent behaviors as ineffective). An example scenario and responses from the Team Role Test is available in Appendix D.

Behavior: Individual behavior

Individual behavior was measured using the Peer Feedback assessment from ITP Metrics (O'Neill et al., 2018). This is a five-item measure where team members provided anonymous feedback on five team member competencies that are associated with team effectiveness. This individual level competency model was developed over 10 years of research by engineers and industrial psychologists in the United States (Ohland et al., 2012). It is used in the itpmetrics.com platform to define effective team players. Participants received an overall score based on the average rating by their peers where a higher score denotes more effective individual behavior. Additional information on the Peer Feedback assessment can be found at https://www.itpmetrics.com.

Behavior: Team behavior

Team behavior was measured using the Team Health assessment from ITP Metrics (O'Neill et al., 2018). This is a 57-item measure where team members provided anonymous feedback on how their team was performing in four key areas Communication, Adaptability, Relationships, and Education. Participants received an overall score based on the average rating by themselves and their team members where a high score denotes more effective team behaviors. Additional information on the Team Health assessment can be found at https://www.itpmetrics.com.

Result: Individual student grades

Due to graduate school deadlines individual student grades were impossible to include in this manuscript.

CHAPTER FOUR

RESULTS

All statistical analysis was performed in SPSS. In order to assess the effectiveness of the training, a one-way analysis of variance (ANOVA) was used to test for statistically significant differences between groups means of the experimental group and control group on each measure. To assess the effectiveness of the delivery of the content in terms of timing (i.e. all at once or over multiple sessions) a two-way analysis of variance (ANOVA) was used to test for statistically significant differences between groups means of the experimental condition one (training all at once) and experimental condition two (training over multiple sessions) groups on each measure. Table 2 presents a correlation matrix between measures.

Reaction: Reaction to Training

Training all at once vs multiple sessions

A one-way ANOVA was used to test for significant mean differences between experimental condition one and experimental condition two. Overall, students reacted favorably to the training with a mean value of 4.15 out of 5. This value fell between somewhat effective and very effective on the Likert-type rating scale. Students who completed the training all in one session had an average score of 4.00, while students who completed the training in multiple sessions averaged 4.20. The mean differences between the two groups was not significant. Table 3 presents sample size, group means, and other relevant descriptives while Table 4 presents the ANOVA table. Figure 2 presents a graph of the response distribution. Based on these results hypothesis 1a was supported, while hypothesis 1b was not supported.

Additionally, I measured what students liked about the training and what they would improve. Participants enjoyed the discussion with team members aspect of training, the videos and situations, and thought the information presented was useful and can improve team performance. However, students would also like to see some improvements made to the training. They would like more videos and situations/scenarios to discuss, make the training more specific and relevant to their engineering courses, and thought that the training could be more engaging.

Learning: Team Role Knowledge

Training vs Control

A one-way ANOVA was used to test for significant mean differences between pretest and posttest measures in the experimental group. Another one-way ANOVA was used and to test for significant mean differences of pretest and posttest measures in the control group. The mean pretest and posttest score for the experimental group was 3.47 and 3.81 respectively, representing an increase of roughly 10 percent. The mean differences between the pretest and posttest values for the experimental group were significant. The mean pretest and posttest score for the control group was 3.72 and 3.76 respectively. The mean differences between pretest and posttest values for the control group were not significant. For the experimental group, Table 5 presents sample size, group means, and other relevant descriptives while Table 6 presents the ANOVA table. For the control group, Table 7 presents sample size, group means, and other relevant descriptives while Table 8 presents the ANOVA table. Figure 3 presents a visual representation of these results.

Training all at once vs multiple sessions

A two-way ANOVA was used to test for significant mean differences between pretest and posttest measures in experimental condition one and two. The mean pretest score for the training all at once group and multiple sessions groups were 3.52 and 3.45 respectively. The mean pretest differences between training all at once and training over multiple sessions were not significant. The mean posttest score for the training all at once group and multiple sessions groups were 3.80 and 3.82 respectively. The mean posttest differences between training all at once and training over multiple sessions were not significant. Table 9 presents sample size, group means, and other relevant descriptives while Table 10 presents the ANOVA table. Figure 4 presents a visual representation of these results. Based on these results hypothesis 2a was supported, while hypothesis 2b was not supported.

Behavior: Individual Behavior

Training vs Control

A one-way ANOVA was used to test for significant mean differences between pretest and posttest measures in the experimental group. Another one-way ANOVA was used and to test for significant mean differences of pretest and posttest measures in the control group. The mean pretest and posttest score for the experimental group was 4.63 and 4.55 respectively. The mean differences between the pretest and posttest values for the experimental group were not significant. The mean pretest and posttest score for the control group was 4.37 and 4.61 respectively. The mean differences between pretest and posttest values for the control group were significant. For the experimental group, Table 11 presents sample size, group means, and other relevant descriptives while Table 12 presents the ANOVA table. For the control group, Table 13 presents sample size, group means, and other relevant descriptives while Table 14 presents the ANOVA table. Figure 5 presents a visual representation of these results. Based on these results hypothesis 3a was not supported.

Behavior: Team Behavior

Training vs Control

A one-way ANOVA was used to test for significant mean differences between pretest and posttest measures in the experimental group. Another one-way ANOVA was used and to test for significant mean differences of pretest and posttest measures in the control group. The mean pretest and posttest score for the experimental group was 4.37 and 4.56 respectively. The mean differences between the pretest and posttest values for the experimental group were significant. The mean pretest and posttest score for the control group was 4.18 and 4.54 respectively. The mean differences between pretest and posttest values for the control group were significant. For the experimental group, Table 15 presents sample size, group means, and other relevant descriptives while Table 16 presents the ANOVA table. For the control group, Table 17 presents sample size, group means, and other relevant descriptives while Table 18 presents the ANOVA table. Figure 6 presents a visual representation of these results. Based on these results support for hypothesis 4a was inconclusive.

CHAPTER FIVE

DISCUSSION

Reaction to Training

Overall, the training was viewed as effective. Evaluating reactions is essentially measuring satisfaction with the training. For the training to be effective it is essential that students react favorably to it, otherwise, students will not be motivated to learn. Furthermore, students will tell others of their reactions to the training, so it is imperative it is viewed favorably. Measuring reactions is important for several reasons. First, it provides valuable feedback that helps evaluate the training modules as well as comments and suggestions for improving the training in the future. Next, it shows trainees that the training is there to help them improve and that their feedback is necessary to determine how effective the training is. Finally, reactions give quantitative information that can be provided to stakeholders and can be used to establish standards of performance for future programs and improve the training as a whole. The feedback provided by the students will allow for improvements to be made to the training to make it more effective in the future.

Learning

The learning measure represents the degree to which knowledge, skills, and abilities, regarding teamwork are acquired by completing the training. Results suggest teamwork training improves team role knowledge by 10 percent and that it did not matter whether students completed the training all at once or over multiple sessions. Teamwork in student engineering context is often assigned to the team as a whole, often without clear declination as to who will perform each task. This creates uncertainty around expectations, introduces a possibility of greater role conflict, and increase the probability that team members will need to have a greater number of teamwork knowledge, skills, and abilities to perform successfully. The results of this study indicate that learning did occur as a result of the training and improved individual student competencies related to teamwork. Literature suggests these individual competencies are transferrable across teams and projects (Salas, Cooke, & Rosen, 2008).

Completing the training all at once or completing the training over multiple sessions did not have an impact on training effectiveness. A recent study found splitting content into multiple sessions lead to greater learning of material when compared to completing all content at the same time, especially when the content was complex and unfamiliar (Kapp, Proske, Narciss, & Körndle, 2015). One possible explanation is that the training material is not complex or unfamiliar enough for splitting the content into smaller chunks to be more effective than completing it all at one time. Engineering students are used to digesting a lot of complex information at one time and can handle all the training content without being overloaded.

Behavior: Individual Behaviors

The peer feedback assessment measures the degree to which participants apply what they learned during training. The results suggest training did not have an impact on individual behaviors. There was however a lack of variability within the data as scores were clustered toward the positive end, possibly due to leniency or liking bias. This is not uncommon however it could possibly mask effects. Additionally, peers may not be able to adequately identify teamwork behaviors. Finally, there may not be an effect and the training doe not improve individual behaviors as assessed by peers. If improving individual behaviors is a required outcome, then perhaps additional training content is needed.

Behavior: Team Behaviors

Preliminary evidence is inconclusive on whether or not teamwork training improved team behaviors. Both the experimental and control group had statistically significant improvement in measures of team behaviors from the pretest to the posttest. Training may improve team behaviors or teams may simply improve by working together. The experimental group consisted of students from an undergraduate course while the control group was made up of students from a graduate level course. It is possible these differences were due to the two groups completing different assignments, course design differences, as well as general differences between graduate and undergraduate students. An example of these differences is although the graduate class (control group) did not receive any training they were provided feedback reports from the Team Health assessment. The feedback report allows students to view the health of their team and prompts them to develop action steps that will enable them to become more effective as a group. Implementing the feedback could have been a cause for the control groups improvement. It would be useful to replicate this study using random assignment within the same course, which was the original intent of this study.

General Discussion

Initial results are promising in that students learned from the training and increased their knowledge, skills, and abilities related to teamwork. There is also possible evidence that the increase in individual teamwork competencies lead to better performing teams, meaning participants were able to apply what they learned from the training to their teams. The feedback provided by the students will lead to improvements in the content, delivery and timing of the training. For example, students would like to add more videos demonstrating correct and incorrect behaviors, add more vignettes, and believe training would be more impactful if it was tied directly to their class material. This study could impact the future of teamwork training in engineering curriculums by providing students and instructors empirically back training to teach teamwork and better satisfy engineering accreditation requirements.

Finally, this study examined the impact of teamwork training, specifically psychological safety and conflict. However, there may be other aspects of teamwork such as communication or coordination, that are more important in this context. Further research is needed to determine what specific aspects of teamwork are most important for engineers to give students and instructors the most bang for their buck in regard to teamwork training and development.

Limitations

The most glaring limitation in this study is that it was not a true experimental design. The original plan was to use random assignment within the same course to place participants in either the experimental or control group. However, due to several factors that was not the case. The experimental group consisted of students in a senior level undergraduate course, while the control group consisted of students in a graduate level course. Although both classes were in the Civil Engineering department, the differences in level and the coursework completed may have impacted the results.

Next, the posttest measures were administered with several weeks left in the semester. Ideally, they would have been collected at the end of the semester. Although the groups worked together on assignments and lab reports inside and outside of class together throughout the semester, the final project is due at the end of the semester and the bulk of the work typically occurs close to the deadline. This research did not capture that aspect and could be improved.

Furthermore, there are possible limitations in using self-report measures and peer ratings. Students may not see gradations of effectiveness for teams and instead simply see functional and dysfunctional. Teamwork may be viewed as an innate quality that one is either good or bad at, instead of a skill that can be developed with practice. It is important to encourage students to develop a mastery mindset around teamwork and team-member effectiveness to get better self-report measures about teamwork. As for peer feedback, there was a lack of variability in the data, possibly due to leniency or liking bias, although this is not an uncommon issue. Additionally, peers may not be able to effectively monitor and identify positive individual and team behaviors.

Finally, the COVID-19 pandemic had an impact on this study. The Clemson University campus shut down during the time this study was being conducted which altered the way classes were delivered and teams interacted. Students went from working together in person to only working together virtually. This could have made it more difficult to identify and monitor individual and team behaviors. Furthermore, there were significant changes to the grading policy where students have the option to get a Pass grade instead of a traditional letter grade. Instructors in the Civil Engineering department have expressed concerns that some students who are in a position earn a Pass have checked out, causing stress and concerns from other students who want to continue to learn and complete the work in their group projects.

Future Research

This thesis only investigated engineering students' improvement in teamwork in one course; longitudinal effects to assess transferability of a student's teamwork behaviors between teams, and across years, was not investigated. Teamwork training should be tested with a cohort of students to track their learning and improvement across multiple teams and multiple years. Exploring this will extend the applicability of teamwork training as an instructional approach to learning teamwork through confirming that the behaviors and skills are applicable across multiple courses and multiple years.

Additionally, teamwork training was only tested in engineering design classrooms while it may be effective in broader contexts. Testing teamwork training in different types of team projects within different areas of study would extend the efficacy of teamwork training through being able to articulate the ideal use cases for different scopes and types of teamwork projects.

Participants reported the training could be more engaging and that they particularly enjoyed the videos, vignettes, and discussion aspects of the training.

Converting the training slides from a PowerPoint presentation to a multi-media format (such as a series of videos) that could demonstrate what the behaviors look like and how they affect team members and provided an opportunity to practice and discuss with their team members may enhance uptake and adoption of teamwork skills. Exploring this will extend the understanding of student improvement approaches developed in this thesis and facilitate a more effective training system.

Conclusion

In conclusion, the training was viewed favorably, individual team role knowledge increased by 10 percent, the training did not impact individual behavior, and the impact on team behavior was inconclusive. Furthermore, completing the training all at once or completing the training over multiple sessions did not have an impact on training effectiveness. Improvements to the content and delivery of the training could be improved to make the training more effective in the future.

APPENDICES

Appendix A

Evaluating Training Effectiveness Summary

Kirkpatrick model evaluation level	**Measure**	**Experimental design**
Reaction	Student reaction to training	Post-test
Learning	Team role knowledge	Pretest/posttest
Behavior	Individual Behavior: Peer feedback Team behavior: Team dynamics measure	Pretest/posttest Pretest/posttest
Result	Individual student grade	Post-test

Appendix B

Program of Instruction

Module 1: Psychological Safety High level learning objective: Provide an overview of the importance of psychological safety in teams	
Focus of learning objectives	**Description of instructional activities**
Learning Objective 1: Knowledge of the definition of psychological safety Learning Objective 2: Knowledge of antecedents and outcomes of psychological safety in teams Learning Objective 3: Identify behaviors present in a psychologically safe environment Learning Objective 4: Be able to diagnose a team's psychological safety Learning Objective 5: Techniques and behaviors to foster psychological safety in teams	INFORMATION: Information based delivery details what psychological safety is, the antecedents and outcomes of psychological safety, behaviors present in a psychologically safe environment, how to diagnose a team's psychological safety, and how to foster psychological safety in teams. DEMONSTRATION: Demonstration based delivery of teams with good/bad psychological safety. PRACTICE: Students will be allowed to practice diagnosing a previous team's psychological safety and ways they will foster psychological safety on their current teams using the information and demonstrations provided. A series of text-based vignettes will allow students to identify and discuss ways in which psychologically safe behaviors could have improved a realistic scenario.

Module 2: Conflict High level learning objective: Provide an overview of the importance of effective conflict management in teams	
Focus of learning objectives	**Description of instructional activities**
Learning Objective 1: Identify the benefits of constructive conflict in teams Learning Objective 2: Know the difference between task conflict and relationship conflict Learning Objective 3: Identify healthy and unhealthy sources of conflict Learning Objective 4: Knowledge of why conflict management is important and best practices of appropriate conflict management in teams Learning Objective 5: Identify skills essential to conflict management Learning Objective 6: Understand why conflict management is critical to team performance Learning Objective 7: Understand the objective of different conflict management styles and which situations they are most effective	INFORMATION: Information based delivery details the benefits of constructive conflict in teams, the difference between task conflict and relationship conflict, healthy and unhealthy sources of conflict, best practices of appropriate conflict management in teams, skills essential to conflict management, why conflict management is critical to team performance, and the objective of different conflict management styles and which situations they are most effective. DEMONSTRATION: Demonstration based delivery of situations with effective and ineffective conflict management practices. PRACTICE: Students will be given the opportunity to discuss in small groups why some conflict management styles are better in certain situations than others. Students will apply the knowledge learned in this module to analyze a previous conflict. A series of text-based vignettes will allow students to identify and discuss ways they would respond to conflicts in a realistic scenario.

Appendix C

Reaction to Training Measure

1. Overall, the teamwork training was:

Very ineffective   Somewhat ineffective   Neutral   Somewhat effective   Very effective

2. What did you like about the training?

3. What would you improve about the training?

Kirkpatrick, D. L., & Kirkpatrick, J. D. (2012). *Evaluating training programs: the four levels*. San Francisco: Berrett-Koehler.

Appendix D

Team Role Test Sample

	Very Effective	Somewhat Effective	Neutral	Somewhat Ineffective	Very Ineffective	**Scenario Description:** • You are the most experienced member of a newly formed production team with several members who are new to this type of manufacturing. • The manufacturing process is complex, requiring compliance with precise standards, to avoid large amounts of product waste and possible equipment damage. • Your supervisor has just informed your team that the sales department had made a “rush order”, committing to ship a large batch of product five days before the anticipated ship date. **Please rate the effectiveness of each of the following responses:**
1.	5	4	3	2	1	a) Immediately touch base with the other team members to find out who is the fastest at each of the manufacturing stations, and allocate tasks among you accordingly.
2.	5	4	3	2	1	b) Avoid being overly assertive in the new team and let others determine the teams direction, because it is important that the younger members take the lead.
3.	5	4	3	2	1	c) Continue with your planned production schedule because it probably won’t be possible to meet the rush order deadline.
4.	5	4	3	2	1	d) Quickly meet with your team members to decide the priority that should be given to the “rush order”.
5.	5	4	3	2	1	e) Meet with each of the team members, encouraging them and clarifying what each will have to do in order to reach the deadline.
6.	5	4	3	2	1	f) Gather the team together and map out a realistic timeline of what must be accomplished in order for the rush shipment to be completed.
7.	5	4	3	2	1	g) Help the team stay calm by letting them know that they shouldn’t be too stressed about meeting the deadline because Sales knew that it was an unrealistic deadline when they made the commitment.

8.	**5**	**4**	**3**	**2**	**1**	h) Try not to react too strongly to the news to help the new team members understand that this kind of rush order occurs far too often.
9.	**5**	**4**	**3**	**2**	**1**	i) Let the team know that although you have not produced an order so quickly in the past, you are confident that by staying focused your team can ship the rush order on time. .
10.	**5**	**4**	**3**	**2**	**1**	j) Suggest that the deadline is unreasonable, and you will simply have to do your best without worrying about meeting the unrealistic shipment date to which the Sales department committed themselves.

Table 1
Total Participants by Measure

Measure	Pretest	Posttest
Reaction to training	N/A	26/37
Team role knowledge	43/65	33/65
Individual behavior	65/65	56/65
Team behavior	65/65	61/65

Table 2
Correlation Matrix

		Reaction_to_Training	Team_Role_Test	Peer_Feedback	Team_Health
Reaction_to_Training	Pearson Correlation	1	.119	-.168	.061
	Sig. (2-tailed)		.563	.411	.768
	N	26	26	26	26
Team_Role_Test	Pearson Correlation	.119	1	-.073	-.170
	Sig. (2-tailed)	.563		.531	.142
	N	26	76	76	76
Peer_Feedback	Pearson Correlation	-.168	-.073	1	.394**
	Sig. (2-tailed)	.411	.531		.000
	N	26	76	125	125
Team_Health	Pearson Correlation	.061	-.170	.394**	1
	Sig. (2-tailed)	.768	.142	.000	
	N	26	76	125	126

Table 3
Reaction to Training Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
All at once	5	4.0000	.70711	.31623	3.1220	4.8780	3.00	5.00
Multiple sessions	21	4.1905	.87287	.19048	3.7931	4.5878	2.00	5.00
Total	26	4.1538	.83390	.16354	3.8170	4.4907	2.00	5.00

Table 4
Reaction to Training ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.147	1	.147	.204	.656
Within Groups	17.238	24	.718		
Total	17.385	25			

Table 5
Learning Descriptives: Training Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	33	3.4660	.37490	.06526	3.2629	3.6691	2.86	4.16
Posttest	20	3.8085	.43398	.09704	3.6756	3.9414	2.90	4.64
Total	53	3.6792	.42825	.05882	3.5612	3.7973	2.86	4.64

Table 6
Learning ANOVA: Training Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.461	1	1.461	9.224	.004
Within Groups	8.076	51	.158		
Total	9.537	52			

Table 7
Learning Descriptives: Control Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	10	3.7154	.52091	.14447	3.4006	4.0302	3.00	4.26
Posttest	13	3.7600	.37476	.11851	3.4919	4.0281	2.92	4.34
Total	23	3.7348	.45384	.09463	3.5385	3.9310	2.92	4.34

Table 8
Learning ANOVA: Control Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.011	1	.011	.052	.821
Within Groups	4.520	21	.215		
Total	4.531	22			

Table 9
Learning Descriptives: Training all at once vs multiple sessions

Time	Training_group	Mean	Std. Deviation	N
Pretest	One time	3.5160	.36679	16
	Multiple sessions	3.4493	.39354	17
	Total	3.4660	.37490	33
Posttest	One time	3.8012	.39278	5
	Multiple sessions	3.8153	.45862	15
	Total	3.8085	.43398	20
Total	One time	3.7333	.38374	21
	Multiple sessions	3.6438	.45755	32
	Total	3.6792	.42825	53

Table 10
Learning ANOVA: Training all at once vs multiple sessions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.479[a]	3	.493	2.998	.039	.155
Intercept	548.032	1	548.032	3332.615	.000	.986
Time	1.093	1	1.093	6.647	.013	.119
Training_group	.007	1	.007	.043	.836	.001
Time * Training_group	.017	1	.017	.102	.751	.002
Error	8.058	49	.164			
Total	726.990	53				
Corrected Total	9.537	52				

Table 11
Individual Behavior Descriptives: Training Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	37	4.6325	.55388	.09106	4.4479	4.8172	2.40	5.00
Posttest	32	4.5489	.55756	.09856	4.3479	4.7500	2.80	5.00
Total	69	4.5938	.55308	.06658	4.4609	4.7266	2.40	5.00

Table 12
Individual Behavior ANOVA: Training Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.120	1	.120	.389	.535
Within Groups	20.681	67	.309		
Total	20.801	68			

Table 13
Individual Behavior Descriptives: Control Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	28	4.3721	.48635	.09191	4.1836	4.5607	3.27	5.00
Posttest	24	4.6057	.26244	.05357	4.4949	4.7166	4.28	5.00
Total	52	4.4800	.41245	.05720	4.3651	4.5948	3.27	5.00

Table 14
Individual Behavior ANOVA: Control Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.705	1	.705	4.424	.040
Within Groups	7.971	50	.159		
Total	8.676	51			

Table 15
Team Behavior Descriptives: Training Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	37	4.3718	.35162	.05781	4.2546	4.4891	3.55	4.78
Posttest	33	4.5571	.36300	.06319	4.4284	4.6858	3.90	4.91
Total	70	4.4592	.36646	.04380	4.3718	4.5466	3.55	4.91

Table 16
Team Behavior ANOVA: Training Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.599	1	.599	4.696	.034
Within Groups	8.668	68	.127		
Total	9.266	69			

Table 17
Team Behavior Descriptives: Control Group

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pretest	28	4.1825	.14143	.02673	4.1277	4.2373	3.91	4.33
Posttest	28	4.5409	.27117	.05125	4.4357	4.6460	4.20	4.89
Total	56	4.3617	.28038	.03747	4.2866	4.4368	3.91	4.89

Table 18
Team Behavior ANOVA: Control Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.798	1	1.798	38.452	.000
Within Groups	2.525	54	.047		
Total	4.324	55			

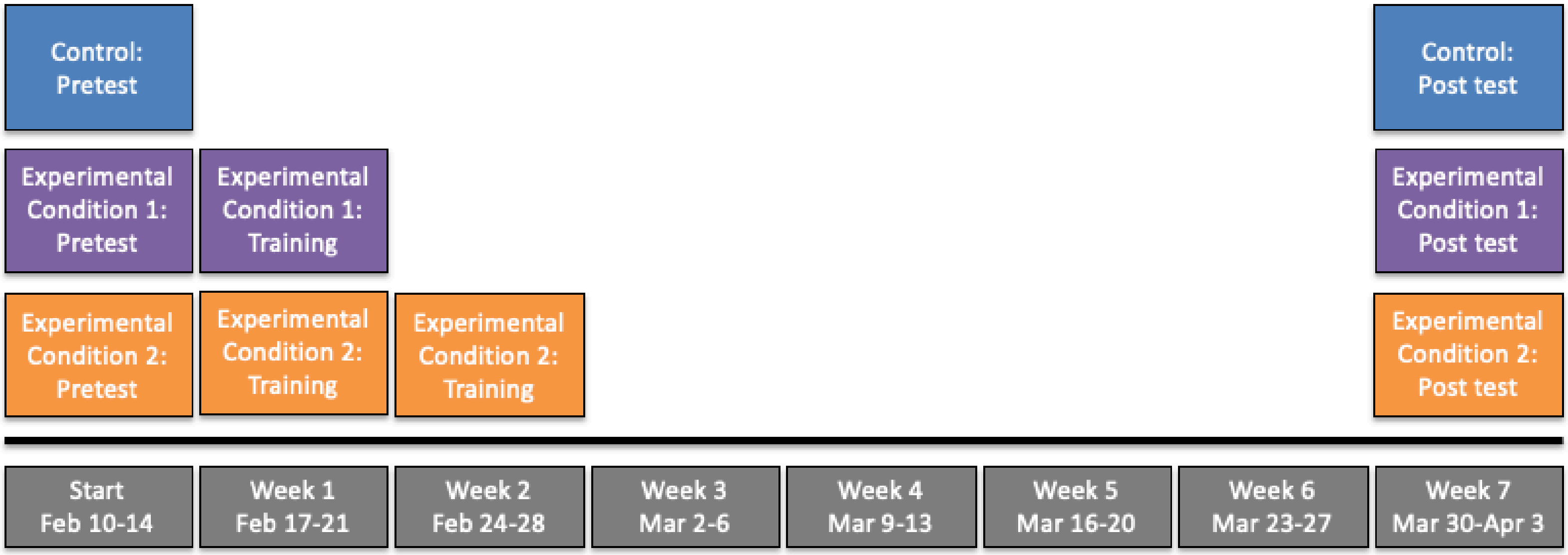

Figure 1
Timeline of Events

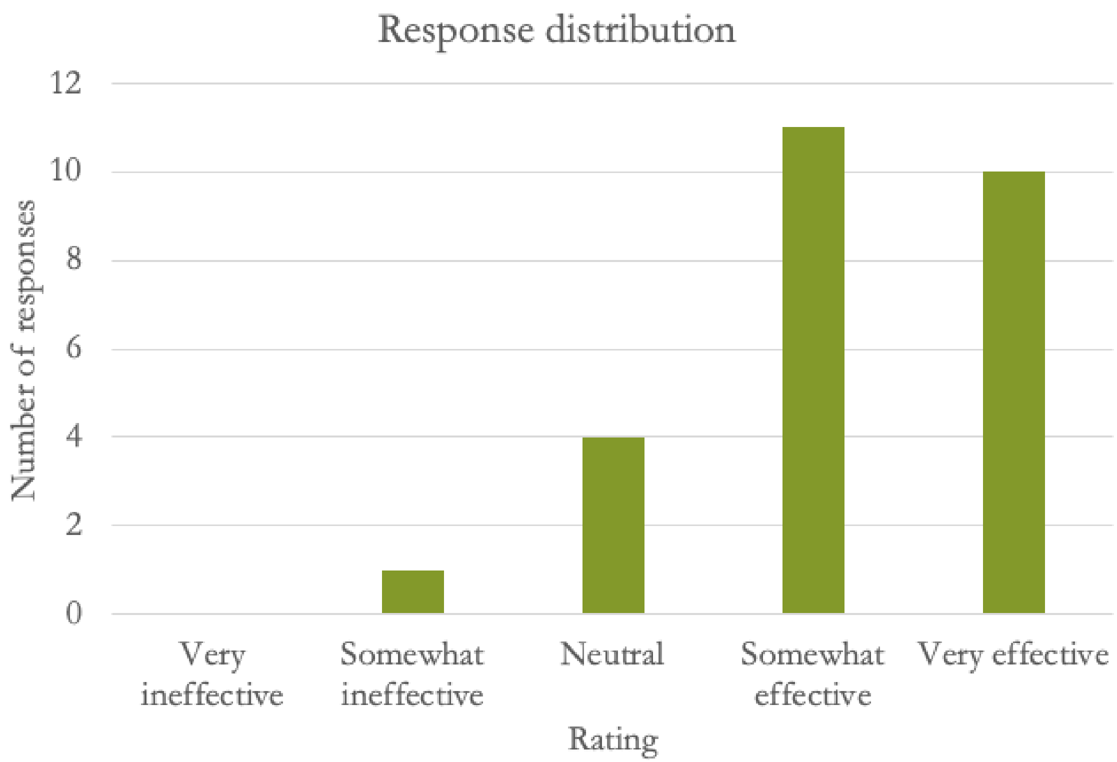

Figure 2
Reaction to Training Response Distribution

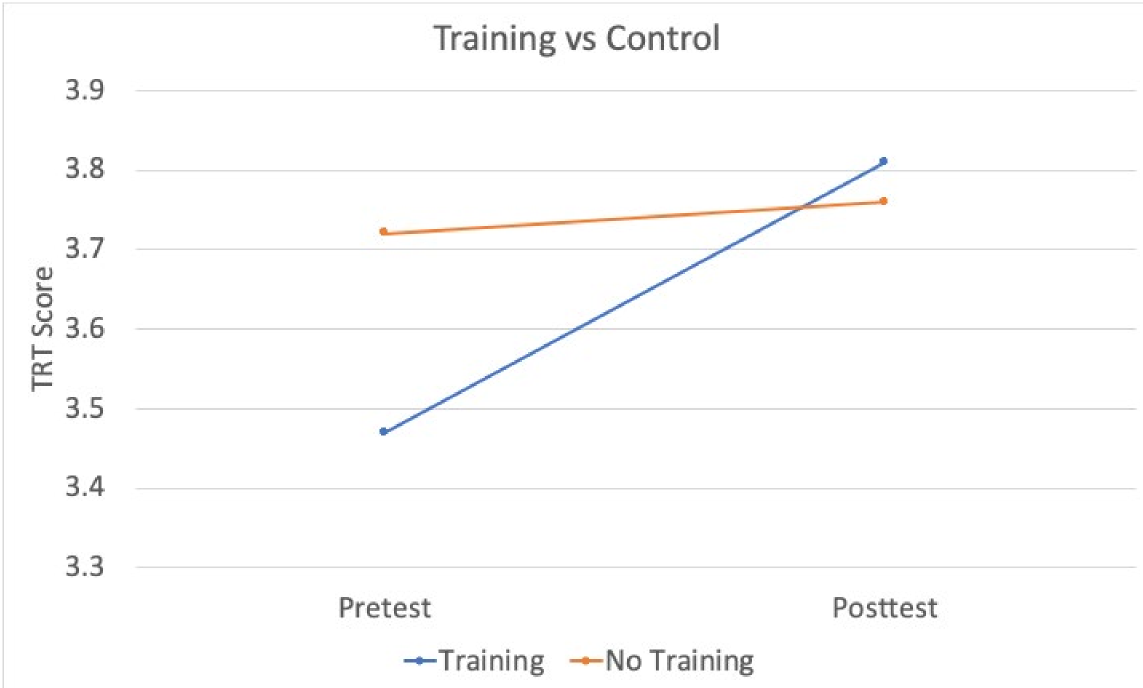

Figure 3
Learning: Training vs Control

Figure 4
Learning: Training All at Once vs Multiple Sessions

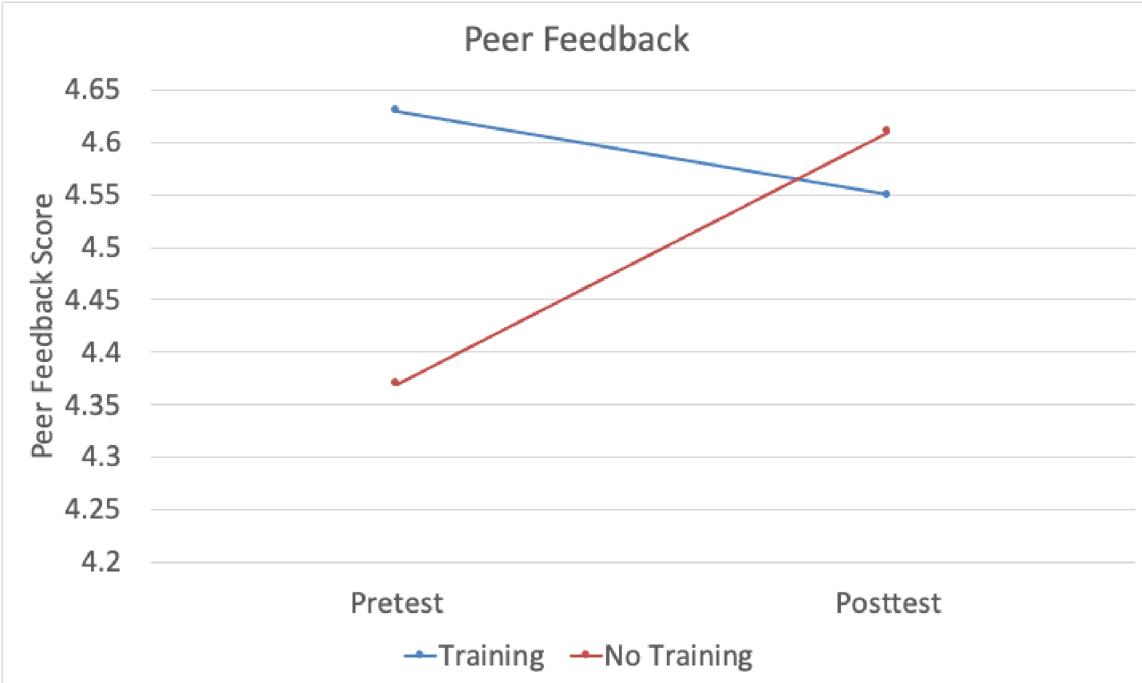

Figure 5
Individual Behavior: Training vs Control

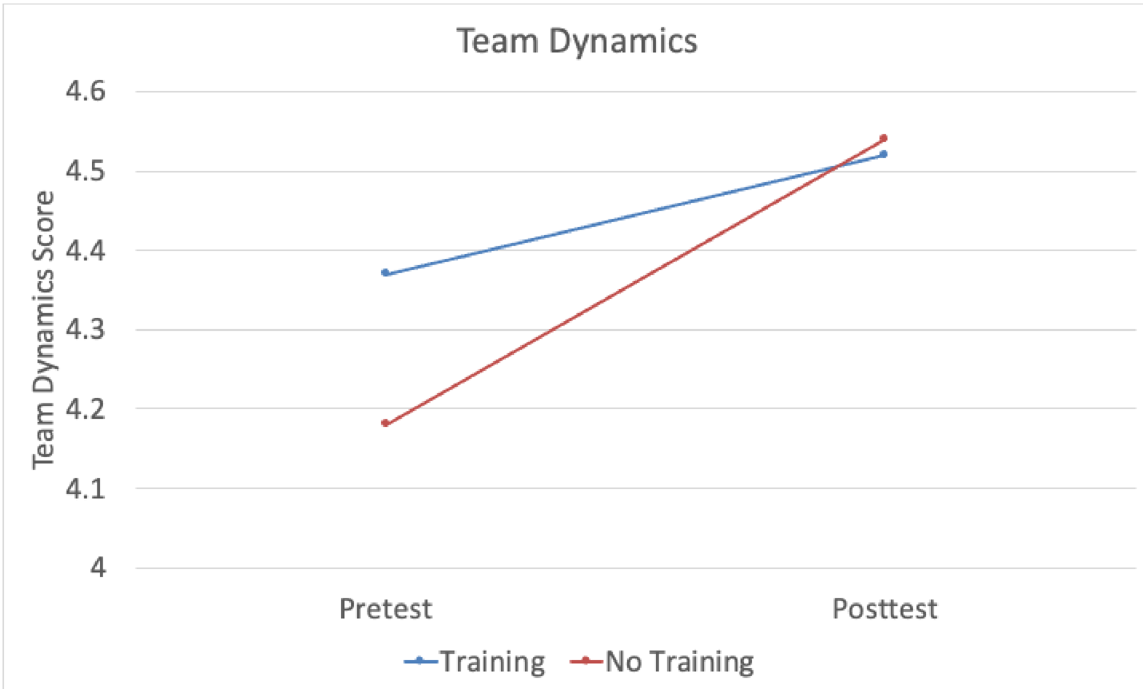

Figure 6
Team Behavior: Training vs Control

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