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TRAINING ADULT VOLUNTEERS TO JUDGE IN COMPETITIVE, NON-TRADITIONAL EDUCATIONAL ENVIRONMENTS USING ONLINE LEARNING

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By

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Dedication

To my bride Jan and my two sons Brayden and Camryn.

Thank you for your patience and support.

We only fail when we cease to try.

Never surrender.

Acknowledgments

I would like to thank my Lord and Savior, Jesus Christ for the hope of life beyond life. Thank you to the members of my committee, Dr. Clif Mims, Dr. Alfred Hall, Dr. Gordon Sutherlin, and Dr. Andrew Tawfik for your support and insight into my work. Thank you Dr. Sutherlin for helping me revive my project and guiding me back on the path. Thank you so very much Dr. Mims, for the vision to see through the process and the reassuring voice to talk me down off the "ledge" when needed. A very special thank you to Dr. Deborah Lowther for your unwavering support, critical eye, and persistent nature to help push, pull, and drag me across the finish line. I am also grateful to Mr. James Simmons and Dr. Darren Mathews for their support of this endeavor while I balanced studies with my work at the Academy. To my family and friends who have supported me through the years — I am forever grateful; I love you beyond words.

Abstract

The purpose of this quasi-experimental study was to examine the comparative change in reported self-efficacy between an experimental group using an interactive, online instructional module and a control group using a traditional handbook. Three research questions were addressed in the study:

1. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to fulfill their role as a judge after controlling for initial self-efficacy?

2. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to understand criteria to assign awards after controlling for initial self-efficacy?

3. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to collaborate with other volunteer academic competition judges after controlling for initial self-efficacy?

Data were collected with a Pre- and Post-Training survey completed by 42 participants (18 experimental; 24 control group). A one-way analysis of covariance (ANCOVA) was conducted to identify differentiation in perceived self-efficacy according to the research questions. Analysis of the data pertaining to Question 2 revealed the participants of the experimental group demonstrated significantly higher change in their belief that they could understand criteria for the assignment of awards over those of the control group. Data for

Questions 1 and 3 revealed higher change in reported self-efficacy for the experimental group over the control group, but the difference was not enough to be considered significant. Results of the open-ended questions showed that participants in the control group desired features prevalent in the interactive, online module such as concrete examples and availability of videos for assistance. Further, they showed that the traditional handbook led to greater cognitive overload in comparison to the instructional design of the online learning environment. It is recommended that future research explore this topic with an increased sample size to enhance generalizability to larger populations.

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Chapter 1 Introduction and Background

When an adult agrees to volunteer, they are giving of their time and energy for a wide variety of reasons including: a belief in the cause, because they want to give back to a community, because they are interested in the work being done, and/or because volunteering simply makes them feel better about themselves (Allison, Okun, & Dutridge, 2012; Allen & Shaw, 2012). If the nature of the volunteer work is outside of the experience or comfort zone of a volunteer, research into Self-Determination Theory shows that the volunteer will intentionally choose to complete the work regardless of its nature, because the underlying reason for volunteering in the first place is such a powerful motivator (Allen & Shaw, 2012). Thus, it is important for those who recruit volunteers to align internal motivators for volunteering with positive experiences in order to increase job satisfaction and enhance the potential for further volunteerism. Studies show that the creation of community through specific role training can have a tremendous influence on increased job satisfaction (Costa, Chalip, Green, & Simes, 2006). Thus, at the core of training for volunteers is the effort to increase volunteer belief structure as defined by self-efficacy, so they can accomplish the tasks for which they have volunteered.

The focus of this study was to examine the role of online adult volunteer training as compared to use of a training manual with regard to increasing the self-efficacy of participants to serve as a judge. The research will add to the understanding of how online instruction can be used to increase the self-efficacy of volunteers through training, identify how organizations can disseminate background knowledge, cultural norms, and expected standards of excellence using online instructional methods, and explore how adults can remotely and individually be taught to work together in small groups.

Problem of Practice

On January 7, 2017, approximately 78,000 high school students from 3,100 robotics teams (*FIRST*, 2017) learned the rules and specifications about the game for the 2017 *FIRST* Robotics Competition. Over the course of the following six weeks, these teams worked together, striving to create a robot best suited to play in the newly configured arena. The game had changed every year offering differing challenges, in both engineering and strategic game planning. These variations forced the teams to provide unique and effective solutions to be successful on the field of play. In 2014, teams of students had to develop robots that could pass a ball two-foot in diameter among collaborating teams prior to firing the ball into a scoring zone. In 2015, the objective was to secure, move, and stack plastic tote boxes and place the stacks onto scoring platforms. In 2016, the robots were controlled to lay siege to their opponents by crossing over a variety of defenses and launch a "boulder" into the windows of the enemy tower. In 2017, the students found out they had to repair an imaginary airship by supplying it with gears, supply fuel to the airship by shooting five-inch spherical whiffle balls acting as fuel cells into a steam engine, and then guide the robot to a rope, which had to be scaled in order to "fly" off at the end of a match. The playing of the game, however, was only part of the competition; teams from all over the world also submitted their work for a variety of judged awards. The awards covered aspects of the robot such as overall quality, unique and creative features, robustness, and robot control systems. Other awards recognized team attributes such as thematic design, team spirit, and the willingness of the team to aid other teams throughout the competition. A final group of awards called upon teams to submit materials before the competition and interview with judges showing how they spread the message of STEM (Science, Technology, Engineering, and Mathematics) in their community and elsewhere. A host of adult volunteers evaluated and chose

their ideal candidates for the awards based upon the presentation of the students and the comparative level of their work with regard to meeting award criteria.

The present study could have significant benefit for the Arkansas *FIRST* organization in that it will provide access to an online and interactive instructional intervention for use with inexperienced judges and potentially with other regional tournaments in the United States and in the eighteen other countries holding *FIRST* sponsored robotics tournaments. This intervention could aid in the standardization of training for inexperienced judges at the 104 local events, increase the levels of self-efficacy of inexperienced judges participating in the events, and increase their working knowledge and understanding of both the Arkansas *FIRST* organization as well as the robotics competitions it sponsors. The intervention also has the potential to aid Arkansas *FIRST* by increasing the job satisfaction of the volunteers and thus increase the number of volunteers that return to work again. The ultimate goal is to develop a highly trained, highly invested group of volunteers who are likely to return as judges at future events. Fahey (2003) emphasizes, "If done well, training will be a strategic recruitment and retention tool by increasing the confidence and sense of achievement" of the volunteers (pg. 1). Serafino (2001) supports this and describes volunteer training as all too often focusing on short-term role requirements rather than on long-term volunteer retention. Avoiding this pitfall is a primary tenant of this research.

Within the field, the study will add to the evidence regarding the use of online instructional interventions for successful training of adults. By presenting evidence that the intervention increased the confidence of inexperienced judges, improved their ability to differentiate between closely related subjects, and improved their self-efficacy to work with others, the study will continue to demonstrate the effectiveness of this particular medium. It will

also open up further opportunities for research into the areas of training adult volunteers to participate in youth athletics, youth civic organizations, as well as in youth religious institutions.

Science fairs and similar competitive organizational structures that aim to reinforce STEM concepts have been around for many years (Czerniak, 1996; Dionne, Reis, Trudel, Guillet, Kleine, & Hancianu, 2012). Educators often encourage students to participate in these competitive environments, as they are seen as beneficial to the students both academically and socially (Grote, 1995; Abernathy & Vineyard, 2001; Wilson, Cordry, & Uline, 2004). As an example, students who worked on teams to build robots and compete in robotics tournaments have been shown to emerge with a positive interest in furthering their education and making career choices in science and technology (Melchior, Cohen, Cutter, & Leavitt, 2005; Welch, 2011).

At times, these competitive, non-traditional educational environments offer clear-cut winners, similar to athletic competitions where objective measures and clearly defined rules of engagement define the scoring. Other times, students win based upon a subjective adherence to an ideal. In these cases, the students are left wondering how they performed, why one entry was judged to be superior over another, and how they can best make improvements to their work so as to better compete in future events. These questions exist certainly in the judging of sports containing subjective elements (Ansorge & Scheer, 1988; Balmer, Nevill, & Lane, 2005; Zitzewitz, 2006), in the judging of expressive endeavors such as art (Kárpáti, Zempléni, Verhelst, Velduijzen, & Schönau, 1998), as well as in other competitive arenas calling for the comparison of someone's work to another (Van Wezemael, Silberberger, & Paisiou, 2011; Chupin, 2011).

One of the issues faced by subjectively based activities, including science fairs and robotics competitions, has to do with judges. Judge recruiters seek volunteers from the community as celebrants of the culture of STEM. These leaders often "are teachers, college/university faculty, physicians, engineers, or others with an interest in the program (Abernathy & Vineyard, 2001, p. 269). Judges within the Arkansas *FIRST* community are intentionally recruited from STEM backgrounds, while other judges are sought as model representatives of successful professionals who see the significance in working with teens (*FIRST,* 2016). Thus, it is certainly possible that the individuals determining the perceived value of one team's work over another often have limited or no background in the organization for which they are volunteering. With Arkansas *FIRST* judges being recruited from fields outside of engineering fields, they will little practical experience in the field of science or robotics; they would not have a complete understanding of the organization for whom they are judging or even the nature of the awards being distributed, and often have to work with complete strangers in making the determinations that award certain teams victories in the judged categories.

Problem Statement

The problem exists then in how to train judges to be an extension of the organization for whom they are volunteering, how to prepare them for assessment of criterion with which they may have little familiarity, and how to work with other judges in arriving at a consensus for awards based upon standards set by the organization. Research does exist into the nature of subjective judging and guidelines and proposals give advice for how to judge at a science-fair (Bellipanni & Lilly, 1999; Rillero & Zambo, 2011; Saunders, 2013), however, research is needed to examine how to train judges to solve the issues explained above.

Purpose Statement

The purpose of this study was to evaluate the effectiveness of an instructional intervention that trains adult volunteers to increase their self-efficacy to work as new judges during robotics competitions. The intervention occurred in cooperation with the organization known as For Inspiration and Recognition in Science and Technology (*FIRST*). *FIRST* began in 1989 with the work of its founder Dean Kamen as a means to increase the influence of science and technology through the development of robotics in a sporting environment (Vision, n.d.). Each January, *FIRST* releases a new game with its rules and descriptions, and then hosts robotics tournaments all over the world in which teams compete to qualify for the World Championships at the end of April. Though the fundamental concepts of each year's game are similar (two alliances of three robots competing against each other during the performance of specific tasks), the robots are substantively different to address the nuances of that year's game. The competitions take place over a three-day time span with teams competing in round-robin style preliminary events followed by an elimination tournament.

As mentioned, in addition to the performances of the robots during the competition, adults judge students for a variety of awards covering a wide assortment of criterion. Judges will award students for creativity in appearance, how students help one another during the competition, and the levels of team spirit exhibited during the event. They will award students for the work they revealed through the creation and performance of their robots. Judges also award individual students for academic excellence and teams for spreading the message of STEM in their community through a series of specialized presentations and interviews.

Judge Advisers work as volunteers for *FIRST*, and recruit local judges for each of the district or regional tournaments. A Judge Adviser is not a judge. Their role is to facilitate the

judging process, to ensure that new judges are trained, that conflicts among the judges are resolved quickly and efficiently, and that the awards distribution matches the ideals as established by *FIRST.* Training for inexperienced judges typically occurs through the distribution of a judge's handbook created by *FIRST*, through informal discussions with the Judge Advisor, and through a meeting the night before the event intended to answer questions and prepare the novice judges further for their role in the competition. This study seeks to prepare inexperienced judges for their role in *Arkansas FIRST* Robotics Competitions through the implementation of an online instructional module.

Questions

This study was guided by the following research questions:

Research Question 1. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to fulfill their role as a judge after controlling for initial self-efficacy?

Research Question 2. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to understand criteria to assign awards after controlling for initial self-efficacy?

Research Question 3. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to collaborate with other volunteer academic competition judges after controlling for initial self-efficacy?

Definition of Terms

The culture of the *FIRST* organization has its own vernacular common among the various teams. The following are terms used within the study:

Arkansas FIRST. *Arkansas FIRST* is an independent organization that partners with FIRST, an international organization that creates the games played annually by thousands of students in 19 countries. *FIRST* is an acronym that stands for "For Inspiration and Recognition in Science and Technology" (*FIRST*, 2016). Dean Kamen founded the company in 1990. Arkansas FIRST hosts the Rock City Regional Robotics Tournament as a qualifying event to send teams to the World Championships hosted by FIRST.

***FIRST* Awards**. Recognition at *FIRST* events is divided into three categories. Machine based awards celebrate feats of engineering and design. Awards distributed for creativity and innovation focus on how teams pushed the boundaries of technology and game play in order to advance the sport. Team attribute awards are focused on intangible qualities that stand out among programs such as team spirit and engineering inspiration.

***FIRST* Robotics Competition (FRC).** *FIRST* Robotics Competition (FRC) (*FIRST*, 2016) is a level of participation within *FIRST*. FRC is open to students from the ninth through twelfth grades.

***FIRST* Robotics Competition Judge Manual.** Every year the leadership of *FIRST* provides a training manual for judges in the form of the annual Judge Manual. Judges new to the process can read through the manual to gain insight on the *FIRST* culture and mission, on the nature and philosophy of the various judged awards, on their responsibilities as judges, and on their anticipated schedule while operating as officials at an officially sanctioned *FIRST* event.

Gracious Professionalism. A term created by Dr. Woodie Flowers to describe the ethos of *FIRST* events by combining an attitude of care and concern for the wellbeing of others with the societal imperative of imparting knowledge and expertise in a responsible way (*FIRST* Robotics Competition Judge Manual, 2016).

Interactive Online Training Module. The interactive online training module is a segmented and structured educational environment where an individual is able to acquire interactive learning experiences through the Internet based upon constructivist principles (Mbati & Minnaar, 2015). These modules are designed to be asynchronous environments allowing for individualized pacing and self-directed learning.

Judge Advisers. Judge Advisers are adult volunteers within a *FIRST* robotics competition who aid in the judging process (*FIRST*, 2017). They are often responsible for the recruitment of judges, but also distribute the judges among the various judged awards, train the inexperienced judges for their work in the competition, and facilitate the judging process to ensure that everything runs smoothly. They are not judges per se, and should have no influence in the selection of winners for the various awards.

Non-Traditional Educational Environments. Traditionally, the school campus serves as the most common educational environment for children in the United States, but other learning opportunities exist for students of school age. The phrase stands in contrast to the expression described by Taylor (2008) as non-formal educational environments. In his work, he describes non-formal educational environments as "more focused on the present, learner centered, less structured, and responsive to localized needs, and there is an assumed nonhierarchical relationship between the learner and the non-formal educator" (pg. 81). For the purposes of this study, the term non-traditional educational environments refers to clubs and

organizations that provide structured, learning settings outside of the traditional school hours. Though these environments can be housed on school property, they exist free of the trappings and forms of the traditional school system in order to provide alternative educational opportunities.

Rookie Judges. New and inexperienced judges within the *FIRST* organization are known colloquially as rookies (*FIRST*, 2015). Rookie judges team up (when possible) with veteran judges during the tournaments. They have limitations placed upon them including restrictions from judging certain awards and participation at the World Championships.

Self-Efficacy. As framed by Bandura (1997) and further developed through subsequent work (Bandura, 2006, 2007, 2012), self-efficacy is a component of social cognitive theory dealing with the perception held by an individual as to their ability to complete a task. It is similar yet distinct from confidence in that it is based on the positive assertion of completion. Whereas one can be confident that he or she will fail at a particular task, perceived self-efficacy relates directly to the successful conclusion of the work being done.

Chapter 2 Review of Literature

Introduction

The competitions hosted by the *Arkansas FIRST* organization require numerous adult volunteers to absorb large amounts of information and reach independent conclusions while still functioning within the structure of a judging team. Of all the volunteer roles, this study specifically looks at the role of judges in the organizational structure of the *FIRST* system. In order to examine how volunteers can make gains of self-efficacy in their beliefs about whether or not they can fulfill their role as a judge, about how well they understand the criteria of their specific tasks, and how well they can work together, it is important to gain insight into how and why people volunteer in the first place. This present research will thus focus on the nature of volunteerism, the methods of training adults, the concepts inherent in instructional design and e-learning, the implications of perceived self-efficacy, and the intricacies of improving collaboration among individuals.

Volunteerism

Hustinx, Cnaan, and Handy (2010) describe volunteerism to be a highly complex and often misunderstood component of support to an organization for which no unifying, integrated theory has been developed. For many organizations, volunteerism is vital to the success of the overall mission of the group (Follman, Cseh, & Brudney, 2016; Michlmayr, 2005; Tulloch, et al., 2015). It was estimated in 2017 that over 971 million people volunteered in a typical year according to the most conservative calculation systems employed in the research of Salamon, Sokolowski, and Haddock (2011). Such a vast number of individuals participating in giving of their time for causes or organizations have a tremendous impact on the ones receiving their assistance. Cravens' (2006) surveys returned highlights of how small companies saw volunteers

as free labor, as pools of experience beyond what their small staff could attain, and as a system of networking that far exceeded possibilities that existed among few numbers of full-time workers. From a cost-benefit alone, volunteers were estimated to bring to their host organization an average per hour value of $23.56 in 2015 (Value of Volunteer Time, 2015). Salamon, Sokolowski, and Haddock (2011) estimated the total economic value of the work provided reached as high as 1.348 trillion dollars in 2005. This valuable resource must be understood, including the motivations for volunteering and how to optimize the volunteer experience in order to realize how best to train them for future work in an organization.

Motivators for Volunteers Who Re-Volunteer

By understanding why people volunteer, the organization can grasp how to make sure the experience of volunteering is a positive one and ensure the highest rate of return for future volunteerism (Eisner, Grimm, Maynard, & Washburn, 2009). Clary et al. (1998) pioneered the research into the field of motivators for volunteering. They identified six general reasons for an individual to volunteer: 1) the values the individual has in regards to giving back to others; 2) a seeking of understanding by the individual; 3) a desire to interact with others; 4) an interest in advancing their personal careers; 5) a need to protect against the negative power of guilt towards their ego for not volunteering; and 6) a desire to enhance the lives of others around them. In another study, religiosity and fun have also been identified as core reasons for volunteerism (Allison, Okun, & Dutridge, 2002).

When an individual cares a great deal about the area in which they are volunteering, they are more likely to return for more work. Fairley, Kellett, and Green (2007) used qualitative analysis to study returning volunteers from the 2000 Olympic games and found that nostalgia, camaraderie, and a connectedness to the Olympic experience were the three chief motivators for

why they came back for the games in Athens. Workers who volunteer are also more likely to re-volunteer when the individual receives a feeling of empowerment either by those who manage the activity or by their fellow volunteers (Farmer & Fedor, 1999; Kim, Chelladurai, & Trail, 2007). Garner and Garner (2011) analyzed 383 surveys covering volunteer motivations and found a positive relationship between retention of volunteers and the considerate voice they had within the organization for which they were serving. Individuals will also repeat a volunteering experience when they feel that their time spent in the work brings value to their life or to the lives of others (Allison, Okun, & Dutridge, 2002; Karl, Pelucheete & Hall, 2007). By actively understanding the motivators for why individuals both volunteer and re-volunteer, organizations can tailor the roles of the volunteer to those that provide the greatest interest, empowerment, and value in order to maintain a strong and vibrant group of workers for their cause.

Experience of Volunteers

Fairley, Kellett, and Green (2007) found that when an individual cared a great deal about the area in which they are volunteering, they were more likely to return to repeat the experience. There is evidence that this might not be so vital however, and that volunteers are just willing to pitch in and do whatever is asked regardless of their role because they see the value in the overall work being done (Allen & Shaw, 2009). Cox (2002) found that volunteers were not opposed to training or assessment to ensure understanding of task, and Pomeroy and Parrish (2013) found a correlation between receiving training and an increase in the levels of comfort and confidence of volunteers after the training. The experience of *FIRST* events also can have positive effects on the companies who promote volunteering with the competitions. Veleva, Parker, Lee and Pinney (2012) measured the impact of volunteering on Underwriters Laboratories in their efforts to support the *FIRST* Robotics Competitions and found positive correlation between the volunteer

experience and increased morale and pride in their company as a result of employee involvement. Such volunteerism and corporate support of volunteerism works in a circular relationship with *FIRST* as they support one another and the children they serve.

Volunteerism in Working With Children

Volunteering to work with children specifically can carry with it a different set of values than in other areas of service. In volunteering to work with children, adults see the work as a moral duty where the lack of pay is like a badge of honor for the labor they perform (Cox, 2002). Others volunteer to maintain a pay-it-forward mentality, seeking to influence future generations out of gratitude for similar work done for them (Bloom, Durand-Bush, Schinke, & Salmela, 1998), to overcome a personal feeling of negativity, or to gain experiences and contacts leading to future benefits (Cornelis, Van Hiel, & De Cremer, 2013). Many volunteers simply are parents who see the experience as being an opportunity to work with their own children in an area of mutual interest and to teach them and their peers about the sport, activity, or organization in which they are participating (Dor & Rucker-Naidu, 2012). Though motivated to volunteer, a major dilemma is that many adults lack a clear understanding of the role in which they are engaged, and mostly go out and wing it to the best of their ability (McKenzie & King, 1982).

Function of *FIRST* Judges as Volunteers

FIRST is an organization that focuses on the inspiration of children in the science, technology, engineering, and math fields (Judge Handbook, 2018). *FIRST* promotes that their organization is filled with a multitude of volunteers (Volunteers make up 99% of the *FIRST*® workforce, n.d.). These volunteers provide a tremendous amount of support and leadership for the 274 events that take place annually around the world. Volunteers do everything from coordinating the work force, inspecting the robots, resetting the game field, and

interviewing the team members for the various judged awards (*FIRST* Judge Manual, 2016). Of all the volunteer roles, this study specifically looks at the role of judges in the organizational structure of the Arkansas *FIRST* system. Judges act in four official capacities: as *FIRST* ambassadors, as role models for the students, as detectives seeking to discover which teams deserve the judged awards, and as reporters seeking to reveal why the teams merited the awards (*FIRST* Judge Manual, 2016). Judges are chosen from among members of the community surrounding the local event and come from a wide variety of backgrounds and experiences. The *FIRST* Judge Manual (2016) also describes how they are responsible for assigning technical awards based upon the functionality and performance of the robot in addition to awards based upon the presentation and marketing efforts of the robotics team as a whole.

Momentum Provided by Volunteers

The term coproduction is used in Brudney's (1990) work on volunteerism to describe a working scenario whereby paid staff members work side by side with volunteers to further an organization's interest. Brudney's work helped set the stage for studies on the benefits and momentum that can be provided by volunteers within a group (Bovaird, 2007, Joshi & Moore, 2006). Within a robotics tournament, all but a few of the organizers and workers are volunteers. These unpaid individuals work hand in hand with the paid staff to run the organizational processes of the tournament in order to create a strong and recognizable product for the high school students involved in the competition. As such, the combination of work produced by paid and unpaid labor would be considered interchangeable and the roles each play would change annually as volunteers step up in a huge way to plan, organize, and run the tournaments (Handy, Mook, & Quarter, 2008). The energy, direction, and vision provided by volunteers' affects every facet of the *FIRST* organization at each event around the nation and in the other participating

countries around the world. Such a benefit to the *FIRST* organization is nearly incalculable in terms of the financial, temporal, and emotional uplift it provides (Salamon, Sokolowski, & Haddock, 2011).

Summary of Volunteerism

Signing up to volunteer carries an emotional benefit to the volunteer and provides a financial and manpower boon to the organization, without which groups who depend on such benefit may not survive. *Arkansas FIRST* is such an organization. It becomes imperative therefore to create environments whereby volunteers have such valuable experiences that they perform their tasks to the highest possible levels and then desire for a return to the experience. Organizations must train their volunteers well on the front end, then, to maximize the volunteer experience and create the connections for success.

Educational and Training Practices For Adults

Learning for adults can certainly occur through experiences in popular culture, exploring public spaces, and opening eyes to informal educational institutions (Sandlin, Wright, & Clark, 2011). This adherence and recognition of a public pedagogy was initiated by Carmen Luke (1996) and has been explored for its impact on the adult learner. This paper will focus however, on the intentional efforts of individuals to oversee, guide, and direct the educational experiences of adults interested in serving as an Arkansas *FIRST* volunteer.

Adult Characteristics for Consideration in Education

Whereas the term pedagogy refers to the general method and practice of teaching, the expression andragogy, popularized by Malcolm Knowles and further developed with Elwood Holton III, speaks to how these methods and practices vary for adults (Knowles, 1984, Knowles & Holton, 2011). Adult learners were identified as being self-directed, they have prior

experiences from which they have created understandings of the universe, and they are internally motivated to learn (Knowles, 1984). Promoters of the educational principal of andragogy such as Glancy and Isenberg (2014) furthered Knowles' ideas by advocating that adult learners have different physiological and psychological structures that frame learning. These structures present as an increased level of self-determination, a variety of experiences that have been gathered over the course of their lives, social skills that have been developed and honed and the ability to see an immediate application for the knowledge and or skill they will acquire (Glancy & Isenberg, 2013). Research by Merriam (2008) also points to an inclusion of the need for increased level of attention being paid to the context in which the adult learner gains their knowledge and the recognition that learning for adults entails many facets of the individual such as their body, emotions, spirit, and mind. Mezirow furthers the research of adult learning through the theory of transformative learning (Mezirow, 1990, 1997, 2000). Mezirow concurred with Knowles that experiences throughout the lives of adult learners shape their mental ideas of how they approach information (Mezirow, 1997). For Mezirow (2000), there were specific moments when preconceptions could be challenged and learning would occur. When the "habits of the mind" and the subsequent "points of view" were questioned, the resulting crises of conflict produced a shift in understanding that would become the new norm (Mezirow, 2000, p. 17).

Interventions for Adults

Different environments can provide a rich tapestry of educational experiences for adults. Each environment has provided opportunities for growth to occur capitalizing on the strengths inherent in the system. Each environment also bears weaknesses that carry the potential to hinder development. This paper will examine five such environments and their use for educational

interventions for adults: face-to-face instruction; asynchronous videos; coaching and mentoring; personal learning environments; self-paced, text based instruction; and e-learning opportunities.

Face-to-face instruction. The transference of information throughout face-to-face interaction in either a traditional classroom or less formal workshop experience has been the go to method of instruction for centuries (Popkewitz, 2011). Only through the relatively recent development of media has face-to-face instruction been challenged as the system of choice with 28% of the educational learners choosing online learning in 2015 (Allen & Seaman, 2016). Research into the ideas behind face-to-face instruction often focus on the difficulties such a model of instruction provides including time and cost factors of meeting in a central location and overcoming shyness, distractions, and the singularity nature of a classroom lecture that can't be reviewed (Glancy & Isenberg, 2013). Face-to-face instruction also is a superior process in the collaboration of people to learn together and is beneficial in the production of creative products (Clark & Mayer, 2011). Further research points out that a main reason why hybrid systems of learning work is not only because of the increased time of study, but through simulating face-to-face connectivity through the relationships formed in interactive learning (Castano-Munoz, Duart, & Sancho-Vinuesa, 2014). Face-to-face classrooms have significant advantages for different populations as the gaps in performance were "most significant among males, Black students, and students with lower levels of academic preparation," (Xu & Jaggars, 2014, p. 651).

Asynchronous video. During the teaching of adult learners who must receive instruction remotely, the use of asynchronous video can be a positive alternative. Videos posted in a cloud-based environment allow the instructor to share experiences and insight on demand (Borup, West, & Graham, 2012) and show a measured increase in transference of craftsmanship skills over static, paper-based instructions (Donkor, 2010). Choi and Johnson (2005) found video to be

more relatable, more memorable, and caused a greater attention to detail than text based instruction while acknowledging the difficulties of video production in the development of instruction. Although the costs of the production of the videos for training purposes can be high, the benefits of being able to see live examples of demonstrated work, capture dangerous and expensive experiments on video, and the ability for the videos to be reused as needed can earn back the value of the video many times over (Donkor, 2010; Jung, 2005).

Coaching and mentoring. While directly teaching to groups of adults provides instructional benefit, coaching adults on a one-to-one basis allows the leader to "encourage and support the process of perspective change" (Cox, 2015, p. 35). Coaching, as defined by the International Coach Federation (2002), "is an ongoing professional relationship that helps people produce extraordinary results in their lives, careers, businesses or organizations," (p 1). Coaches work to assist the learner through building relationships that allow the coach to provide intellectual and emotional support throughout the process of wrestling with new and challenging information (Cox, 2015). Coaching provides a focus on the learner through direct and personal contact, pays close attention to setting goals and meeting them, and carries a sense of equality between coach and learner that aids in the instructional process (Ciporen, 2015).

Sammut (2014) found that there were four foundational themes that were considered vital for the overall success of the coaching relationship. First, there needs to be a special consideration given to the space and context of the coaching being given. A physical space for meeting and more importantly, a specific and defined time needed to be established in which the coaching would occur. Second, the power of the relationship between the coach and the one being coached needs to reside in the one seeking the learning. By allowing control for the flow information to proceed as requested, the learner is able to set the agenda and seek the knowledge

more readily. Third, the language used by the coaches should be carefully and rigidly controlled to ensure that the learner never felt belittled, yet was still challenged in their thinking processes and beliefs. Finally, the coaching process pushes for two goals: a transformation of the thinking of the learning and clarity of thought or understanding.

Personal Learning Environments. There are a variety of terms that are often used interchangeably and sometimes distinctly when it comes to an individual's self-guided efforts to use technology for learning. Haworth (2016) describes Personal Learning Environments (PLEs) as "Web 2.0 and social media technologies that enable individual learners to manage their own learning," (p. 360). These cloud-based, digital environments allow for the learner to create relationships with other learners, often called Personal Learning Networks, for the sharing and dissemination of knowledge and understanding (Harding & Engelbrecht, 2015). PLEs create channels of communication and avenues for learning to be delivered to the user based upon the user's preferences, learning styles, and interests. Wu (2017) warns that despite the perceived benefits of the PLE, there is often a hazy line between educational interactions between students and social interactions among the same population. These lines can easily be crossed and must be monitored for focused attention and self-regulation to prevent learning opportunities to be overwhelmed by too much information coming through their PLE networks leading to overload and irrelevant tasks being shared by and with their peers (Wu, 2017).

Self-paced, text based instruction. The printed word revolutionized instruction and opened up education to the masses. With the evolution of instruction following the development of media to supplement and/or supplant text based instruction, traditional interventions using only text have seemingly had to defend for validity. This isn't always the case. Choi and Johnson (2005) found that the although there was significant differences in attracting the attention of

learners with video interactions, there were no significant differences in understanding among those who participated in the control group using text based intervention. In their work with medical students, Chang et al. (2017) found text based instruction and testing led to higher achievement, than similar interventions with multimedia and that "multimedia elements improve a test item only if it adds further details not possible with text," (p. 903). This might be because of the preconditioning medical students have experienced throughout their formative educational experiences, but it still goes to show the power of self-paced text interventions.

e-Learning. Leaders in training adults have explored electronic means of delivering professional development to increase the effectiveness and accessibility of training (Laferriere, 2006). Many corporations see greater efficiency in the use of time and financial resources by providing learning opportunities for individuals across a digital platform (Chen, 2010). Research continues to explore the best conditions for learner acceptance of e-learning environments. Selim (2007) found that within a university setting, the critical success factors centered around five major categories: 1) attitude and acceptance of e-learning by the instructor; 2) motivation, technical competency of the student, 3) interactive collaboration of the student; 4) structure, content, and style of the information technology; and 5) the degree and effectiveness of support offered by the university system (p. 408). Sun and Rueda (2012) established that the amount of interest in an e-learning topic correlated directly with the learner's perceived success, and that the higher the emotional attachment of the learner to the material being learned, the more powerful the impact of the environment on the learner. Milheim (2001) concluded that successful e-learning modules should: 1) provide self-directed learning opportunities; 2) promote social interactions fostering deep and critical exchanges among adult learners; and 3) avidly avoid

directly leading instruction in order to facilitate growth and development within their learners (p. 29).

Summary of Adult Learning

There is no question that the instructional world is moving to online learning at a rapid pace as it allows for previously impossible flexibility in delivery methodology and mechanics such as time, location and pacing. One of the biggest issues is focusing attention to the material and away from distractions. Another is the creation of relationships with the learner to maintain connectivity to the instructor and the intervention itself. Learning is a difficult and challenging prospect, as new information is assimilated and previous understandings challenged within. Providing well-designed, relatable and interactive e-Learning experiences are the keys to capturing the attention of the learner and holding them long enough for the roots of deeper knowledge and understanding to take hold.

Instructional Design and e-Learning

A technological and cultural shift has occurred in the how instructional interventions can and should occur. E-Learning at its most basic form is "the use of electronic technologies to create learning experiences," (Horton, 2012, p. 6). E-Learning opportunities are arising across the landscape as educational and corporate institutions seek to take advantage of the benefits and minimize the barriers to e-Learning. The following section explores these benefits and barriers and how they might apply to the proposed intervention.

Benefits to e-Learning Interventions

E-learning interventions can provide significant advantages to the transmission of skill, knowledge, and understanding. Learning via digital means allows for learning to occur any time and any place (Chen, & Yeh, 2008); learning to occur at the learner's pace and around the

learner's schedule (Jézégou, 2013); and learning to be group oriented while conforming to an individual's needs of time, location and learning style (Liaw, 2008; Magnussen, 2008; Rhode, 2009; Sun, et al., 2008). E-learning through the use of multimedia formats also provides the learner with a wide variety of learning channel inputs that allow for written text and verbal narrations to be presented simultaneously, increasing the speed at which the learner learns and decreasing the effort it takes to do so (Adesope & Nesbit, 2012; Sadaghiani, 2012). The amount of control one has in the processing and reviewing of learning materials has been shown to aid in the acquisition of new knowledge (Sage, Bonacorsi, Izzo, & Quirk, 2015; Zhang, Zhou, Briggs, & Nunamaker, 2006). Benefits of e-learning intervention use have also found to impact the perception of learners towards their perceived comprehension of the material, regardless of actual results on assessments (Stelzer, Brookes, Gladding, & Mestre, 2010).

Barriers to e-Learning Interventions

Though there are significant benefits to the use of e-learning interventions, barriers do exist. The following are among the various factors limiting the successes of e-learning interventions: 1) fear and anxiety can cripple students faced with the need for change; 2) there can be significant time, costs and other resources involved in the development and testing of instructional materials; 3) debilitating levels of self-discipline are often needed for success within e-learning environments; 4) inadequate levels of technology exist both in volume as well as capacity limiting access of the learners to the materials they need; 5) there is a need for face-to-face interactions with leaders and peers that are hindered through the use of digital mediums; and 6) there exists high levels of anxiety faced by individuals with the use of technology in general, more so than in a traditional educational environment (Childs, Blenkinsopp, Hall, & Walton, 2005; Liaw, 2008; Kupritz, Lim, & Morris, 2007). These barriers occur frequently enough within

the developed and technologically advanced culture of the United States and other first-world powers to be a hindrance to the development and usage of e-learning interventions. For the developing world, these obstacles can be insurmountable.

For the instructional designer working with adult training, understanding the benefits and barriers to e-Learning environments is key to successful intervention creation. Through the successful creation and implementation of instructional modules, volunteers will feel better prepared and more capable of performing the tasks to which they will be assigned. This confidence will expressly carry over into their work and the likelihood of their returning for future volunteer opportunities. By identifying and targeting instruction to increase the belief that a volunteer can perform work, the designer will be taking important first steps in the volunteer process leading to an improved overall ecosystem of volunteerism.

Self-Efficacy

For organizations seeking to train volunteer staffs, being able to have a positive affect on the self-efficacy of its workers will yield benefits both in the quality of their work and in the likelihood that they will return to volunteer again. Self-efficacy is a part of the social cognitive theory developed by Bandura (1997) that puts forth the concept that learning doesn't come solely through experiences, but also through social observances and interactions. There are four components of social cognitive theory and the ultimate goal of the individual to realize goals: self-observation, self-evaluation, self-reaction, and self-efficacy. Bandura's (1997, 2006, 2007, 2002) work on self-efficacy was chosen for this research because of its foundational understanding of action. Self-efficacy refers to the belief one has in their ability to perform a particular task and is gauged by the individual through four different sources of information: performance outcomes, vicarious experiences, verbal persuasion, and physiological feedback

(Bandura, 1997). Of the four, performance outcomes are seen as the chief instruments through which the individual mostly gauges their competency as past performances are seen as the best predictor of future implementations. Self-efficacy is not based upon "what one *has* but with belief in what one *can do* with whatever resources one can muster" (Bandura, 2007, p. 643). Thus, the term self-efficacy is significantly different than self-esteem; whereas self-esteem refers to the basic conclusions one holds in reference to the self, self-efficacy refers to how one feels one can perform (Judge & Bono, 2001).

This foundational belief is empowering and beneficial to the whole person as Scholz, Gutiérez Doña, Sud, and Schwarzer (2002) explained stating, "…a person who believes in being able to produce a desired effect can lead a more active and self-determined life," (p. 242). Pasupathy and Bogschutz (2013) point out another feature of the popularity of self-efficacy is its ability to be predictive in nature for future performances. Bandura identifies the concept of self-efficacy as not to be generalized across all areas of the individual's structures of belief, but must be classified with the particular construct under consideration (Bandura, 2006). Bandura takes the idea of self-efficacy to a deeper level in his 2006 chapter on creating self-efficacy scales by stating:

> Efficacy beliefs influence whether people think erratically or strategically, optimistically or pessimistically. They also influence the courses of action people choose to pursue, the challenges and goals they set for themselves and their commitment to them, how much effort they put forth in given endeavors, the outcomes they expect their efforts to produce, how long they persevere in the face of obstacles, their resilience to adversity, the quality of their emotional life and how much stress and depression they experience in coping with taxing environmental demands, and the life choices they make and the accomplishments they realize. (Bandura, p. 309)

Thus, Bandura sees the concept of self-efficacy as the chief ingredient in the overall successes that individuals have in life due to their flexible beliefs in their own capacity for ability. It is this ability and how to measure it that will be explored next.

Measurement of Self-Efficacy

Self-efficacy is often assessed in a global manner in regards to how the individual feels they can handle tasks or situations that arise in every day life using tests like the Generalized Self-Efficacy Scale (Chen, Gully & Eden, 2001). Bandura wasn't this specific and allotted for wide ranging tests that measured self-efficacy using rating scales from 1-100, where "1" typically represented the perception that the individual could not do the activity at all and "100" represented the perception that the individual was highly certain they could perform the activity, (Bandura, 2006). He believed that allowing for a broad spectrum of response options would be stronger due to the avoidance of individuals to extreme positions. It is difficult to utilize self-efficacy tools across multiple areas of skill as Nandeshwar and Jayasimha (2010) explain: "High self-efficacy in one area may not coincide with high self-efficacy in another area. Self-efficacy is specific to the task being attempted," (Nandeshwar & Jayasimha, p. 42).

Other such self-efficacy survey instruments have been recently adapted to the 5-point Likert-style scale (Croasmun & Ostrom, 2011). By utilizing Cronbach's alpha for internal consistency reliability, Croasmun and Ostrom (2011) felt the 5-point Likert-style scale would show an instrument that was suitable for measuring self-efficacy.

Nature of Self-Reported Self-Efficacy

In their meta-data analysis of studies published to identify self-efficacy in physical activity behavior, Ashford, Edmunds, and French (2010) found that knowledge acquired through vicarious experience and feedback produced the highest gains in self-efficacy by the individual.

Self-efficacy has been shown to improve through specific training targeted at knowledge related to particular tasks in health education (Clark, Clark, & Brey, 2014; Ng, et al., 2013; Goldenburg, Andrusyszyn, & Iwasiw, 2005). Bandura recognized that other influential factors are at work in the understanding of motivation and behavior such as "goal systems, outcome expectations, perceived environmental facilitators and enablers, and environmental impediments" (Bandura, 2012, p. 40). For the purposes of this study, however, only self-efficacy will be measured and analyzed.

Summary of Self-Efficacy and *FIRST* Judges

Self-efficacy as a tangible belief in the ability to perform a task should be a primary focus of interventions equal to the actual transference of information or skill. Arkansas *FIRST* judges who walk into the arena for their rookie season must not only have the knowledge and understanding to evaluate the teams and their robots, they must carry with them a confidence that is perceptible by the students so that they can feel secure in the final results. Through the creation of an interactive module that uses formative evaluations throughout, it is believed that the self-reported confidence of the potential judges will rise primarily through the performance outcomes component of self-efficacy. By crafting and implementing an intervention that can positively affect the self-efficacy of rookie judges, the researcher hopes to assist the Arkansas *FIRST* community for the betterment of the organization and for the experience of those who give of their time and efforts to volunteer.

Collaboration Skills

For judges to determine the most-deserving teams, they must work in groups and jointly arrive at a conclusive outcome. Such camaraderie of purpose and teamwork is achieved through collaboration, an "activity of multiple parties coming together to work toward a mutually

beneficial common goal," (Shah, 2012, p.4). Collaboration is a study of group dynamics and shared processes. It has had an increase in interest in the past few decades with the prospect of maximizing group interplay with technology in a field known as Collaborative Information Seeking Systems (CISS). CISS combines the mechanics of information retrieval with information gathering, and information sharing for the purpose of producing work or making decisions (Paul & Reddy, 2010). A leader in the field of CISS, Shah (2009) developed the C5 model (Figure 1) to better understand the interplay between collaboration, cooperation, coordination, contribution and communication.

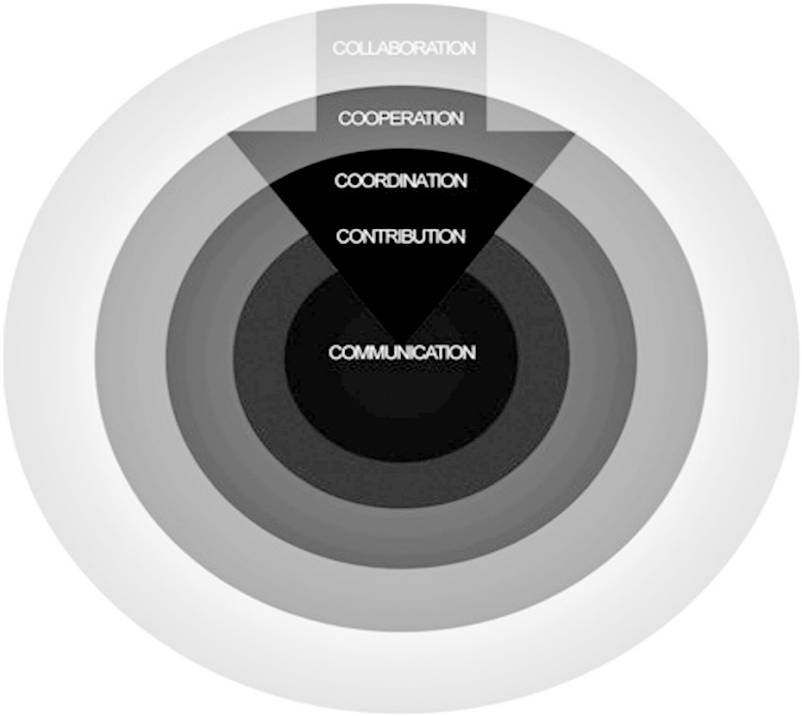

Figure 1. C5 Model of Collaboration (Shah, 2009)

Liechti and Sumi (2002) push further the idea of collaboration with the idea that true collaboration can be generated only through specific types of awareness to the goals of working together: 1) group awareness: providing information to each group member about the status and

activities of the other collaborators at a given time; 2) workspace awareness: a common workspace that the group has where they can bring and discuss their findings, and create a common product; 3) contextual awareness: the identification of what content is useful for the group, and what the goals are for the current project; and 4) peripheral awareness: the kind of information that has resulted from personal and the group's collective history (p. 1-2).

Collaboration is subdivided between division of labor and sharing of knowledge (Foley & Smeaton, 2010) where individuals bring their different skills to bear and accumulate information for the benefit of the group and distributes the information to the collective for greater understanding and or decision-making. Group activity is often defined by its ability to share information (Yao, Neches, Ko, Eleish, & Abhinkar , 1999). Organizers of groups must allow collaborators to exchange information and ideas seamlessly so that the group as a whole benefits from the influx of information that is brought to the table.

Conclusion

In March, when the Arkansas *FIRST* Robotics Competition tournament season begins, many inexperienced judges will lack core fundamental training on how to perform in their roles during the events. Some of the judges will be engineers seeking to give back to their community, some will be individuals working within a science and technology field who are intrigued by the nature of the robotics event. Yet others will be volunteers who simply enjoy helping young people see success in their efforts outside of the formal educational environment. For the success and continued growth of the Arkansas *FIRST* program however, it is necessary to enable rookie judges to go beyond their instincts and experiences by providing access to training that can improve their self-efficacy to fulfill their roles and responsibilities. Though often thought of in the sense of performing a particular activity when facing challenges, self-efficacy in this study

will include the ability of the individual to work with others. The ability to compromise and collectively reason within a group is one worth studying and as a skill ties in directly with collaboration. By increasing the self-efficacy of the rookie judges on the front end, their involvement in the process will start from a highly positive state enabling them to have a higher degree of success during the event and a higher degree of probability that they will return as volunteers at a later date.

Chapter 3 Methodology

Introduction

The study sought to evaluate the ability of an interactive, online instructional intervention as compared to informal handbook training, to affect the self-efficacy of adults. The intervention used asynchronous online training to prepare adult volunteers to work as first-time judges in a *FIRST* Robotics Competition (FRC). The phrase "rookie judges" is an official term used by the Arkansas *FIRST* organization to identify those adult volunteers who are experiencing the role of judge for the first time (See also definitions in Chapter 1). This chapter presents the research methodology, which includes the research questions, research design, participants, research context, materials, instruments, procedures, data collection, data analysis, limitations, delimitations, and bias/subjectivities.

Research Questions

Three research questions were developed to guide the research:

Research Question 1. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to fulfill their role as a judge after controlling for initial self-efficacy?

Research Question 2. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to understand criteria to assign awards after controlling for initial self-efficacy?

Research Question 3. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential

volunteer first-time academic competition judges to collaborate with other volunteer academic competition judges after controlling for initial self-efficacy?

Research Design

The study followed an experimental, quantitative format to address the research questions using Pre-Test – Post-Test non-equivalent control grouping. The experimental strategy was employed because of its ability to control for one or more independent variables and infer causality within the research (Kirk, 2013; Leedy & Ormrod, 2001). This experimental research followed the design as described by Creswell (2014) in that it sought to identify if the implemented interactive intervention alters the self-efficacy of participants to a greater degree than the changes exhibited by the control group who received a text-only, non-interactive manual in portable document format (pdf). Data were gathered by surveys administered to an experimental group of potential rookie judges before and after their participation in the intervention. A control group of potential judges completed the same surveys prior to and following their reading of the traditional methods of training. Although Pre-Testing could have influenced the results of a Post-Test by conditioning the participant to desired results (Dimitrov & Rumrill, 2003), the Pre-Test-Post-Test design was selected because of its ability to aid in understanding change following an intervention (Levy & Ellis, 2011). Quantitative data were gathered with a researcher developed online Pre-Test and Post-Test using a 5-point scale, Likert-style items.

Participants

Every year in the United States, there are over 150 first-time judges working worldwide as adult volunteers in *FIRST* Robotics Competitions. Specifically, this study included 42 potential rookie judges as the participants for this study. Participants in the experimental and

control groups of the study were randomly sampled and assigned from individuals who had either demonstrated interest in volunteering at an FRC event or who had been recommended as candidates for such a role. Participants were sampled from the pool of potential rookie judges identified by the Arkansas *FIRST* representative known as a Judge Adviser as well as by other contacts who were recommended as possible future judges. Thirty emails invitations were sent out to potential judges as identified by the local Judge Adviser of the Arkansas *FIRST* organization. An additional 40 email invitations were sent out to potential judges as identified by other contacts within STEM related fields or professional contacts. Once this sample of potential rookie judges had been identified, random sampling techniques were used to assign participants to either the experimental (18 participants) or the control group (24 participants).

Research Context

The overall context for this study was based on the FIRST Robotics Competition (FRC) judge training. All participants had shown either interest in volunteering to serve as an Arkansas FRC judge or were recommended as being potential judges and agreed to complete the required judges training. Although the context for both the experimental and control groups required the use of technology to access online training materials, the difference occurs in the format of the training materials to be completed by the groups. The experimental group completed the interactive, online module *FIRST Robotics: Judges Training*, whereas, the control group read through the 2017 *FIRST* Robotics Competition Judge Manual, produced by the *FIRST* organization.

Materials

This study used two formats of training materials to prepare potential judges for *FIRST* Robotics Competitions. The experimental group format was an interactive, online training

module, as compared to the control group, which received the annually revised training manual in digital pdf format.

Experimental Group Materials

The experimental group completed the online intervention, *FIRST Robotics: Judges Training* (Appendix A). The intervention was designed using the Morrison, Ross, Kemp, and Kalman (MRKK) (2013) model of instructional design and underwent a formative evaluation for efficacy. The course was developed and refined using the behavioral and cognitive processes identified in the MRKK instructional design model. Following this holistic model to instructional design, a needs assessment was used to identify an instructional problem for the intervention. This problem demonstrated a need for an online instructional module, which was developed using the two Chief Judge Advisors from *FIRST* as subject matter experts. Following the development of the module, the intervention underwent a three-phase formative evaluation consisting of further subject-matter expert review, one-on-one and small-group trials yielding results showing the unit to be effective.

The intervention was a web-based site designed for asynchronous interaction with the material by the learner. The module consisted of a Pre-Test, a history of *FIRST*, a presentation of its culture and purpose, a breakdown of the awards to be given by the volunteer judges, a section on working together as judges in a group, and a summative Post-Test over the material contained within the intervention. Although the module covered the same content as the Judge Manual provided to the control group, the differences occurred throughout each section of the intervention, in that interactive practice and feedback opportunities were provided for learners to quickly check for understanding of the material. The current research was seeking to compare levels of self-efficacy in regards to the participant's ability to perform as a judge and work with

other judges in the group between the experimental group who had access to the intervention and those who solely had access to the traditional training resources.

Control Group Materials

The control group materials consisted of the 2017 *FIRST* Robotics Competition (FRC) Judges Manual (Appendix B). The manual was a 64-page pdf document, which participants could view online or download and print. The manual included ten sections: 1) Introduction to *FIRST*; 2) The FRC Judge Assistant, Judge, and Judge Advisor; 3) FRC Judge Information; 4) FRC Judged Awards; 5) Chairman's Award Judging; 6) *FIRST* Dean's List Award; 7) Entrepreneurship Award; 8) FRC Judge Advisor Processes; 9) FRC Event Types; and 10) Appendices. The information was presented in a text only format with no questions or review elements following the readings.

Instruments

This study used two, researcher-developed instruments, the Pre-Training Survey (Appendix C) and the Post-Training Survey (Appendix D). Both instruments were administered in an online format to both the experimental and control group participants prior to and following the completion of the training. The surveys had been designed to identify levels of self-efficacy as defined by Albert Bandura (1997, 2012) in his seminal studies on the nature of perceived belief in the ability to successfully complete work. Although Bandura (2006) recommends self-efficacy scales to be numerically broad in nature to allow for the greatest degree of expression for the participant, Brill (2008) shows that a more limited number of choices aids in the reliability of the instrument. The survey was thus comprised of 15 questions using a traditional (Lozano, Garcia-Cueto, & Muniz, 2008) 5-point Likert scale with an answer of "1" being "I cannot do this at all", an answer of "2" being "I am not sure if I can do this," an answer of "3"

equating to a “I think that I can do this” answer, an answer of “4” equating to an “I am certain I can do this” response, and a “5” as an “I am highly certain I can do this.”

Pre-Training Survey

The purpose of the Pre-Training Survey was to collect information from the participants regarding levels of perceived self-efficacy to perform as a judge in three different categories before they completed training materials. The survey began by asking participants to enter their Study ID number. Next, were 15 items designed to ask the participant to rate confidence in their ability to perform five versions of each of three tasks: performing as a judge, distinguishing between the criteria for the awards, and working with fellow judges. The Pre-Training Survey was administered via a Google Form to which each of the participants gained access by an emailed link to the survey. The Google form survey was programed to present items in random order with each use.

Post-Training Survey

The purpose of the Post-Training Survey was to gather information to demonstrate any changes in perceived self-efficacy following completion of the training materials: experimental group completed the online intervention and the control group completed the manual. The Post-Training Survey also began by asking participants to enter their Study ID number. The survey then presented the same 15 items as included on the Pre-Training Survey; however, once again the items were randomly arranged for each participant. The Post-Training Survey also included two open-ended items to further explore differences between experimental and control group self-efficacy. The first item asked, “In the space below, please share which aspects of the First Robotics Competition (FRC) Judges training were most helpful in preparing you to be a FRC Judge, and why.” The second open-ended item asked, “In the space below, please share how the

First Robotics Competition (FRC) Judges training could be improved, and why." The Post-Training Survey was administered via a Google Form that could be accessed by an emailed link to the survey.

Development of Instruments

The author of this dissertation, the study's chair, and research librarians at the University of Memphis conducted extensive research to identify validated scales that fit the needs and parameters of the study. Scales such as the Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995) were evaluated to best identify the genre of questions to be used on the Pre-Training and Post-Training surveys. This proved to be a difficult task in line with Banduras belief that "there is no all-purpose measure of reported self-efficacy," (Bandura, 2006, p. 307). The final questions themselves went through a multi-stage, iterative process in conjunction with the chair and subject matter experts with over 17 years experience in judging at *FIRST* competitions. The final 15 questions were specifically assigned to the three research questions and worded according to Bandura's guide for the development of self-efficacy scales with the exception being to use the five-point Likert-style system of evaluation in lieu of the broader 100-point scale as advocated by Bandura (2006).

Procedures

This study implemented two primary procedures. The first procedure was the recruitment of participants for the study. The second procedure was how the study was conducted in order to gain understanding of the changes in the potential rookie judge's perceptions of self-efficacy after training.

Recruitment of Participants

Judge Advisers are responsible for recruiting judges or working with a Judge Coordinator whose function is to gather local volunteers for the job. After receiving IRB approval (Appendix E), the researcher communicated with the Judge Adviser of the Arkansas Rock City Regional via email to request names and contact information of potential rookie judges who had indicated that they had an interest in volunteering as judges (see Participant Referral Email Appendix F). In addition to the above volunteers, participants were also recruited by the researcher from among potential judges in the community who had not yet indicated availability for being a judge in the current season. Contact information for these participants was gathered from recruitment emails (Appendix G) sent through professional (business, education, health, government, etc.) organization emails lists and recommendations from STEM leaders around the country.

Upon receipt of the information regarding the potential judges, the researcher sent a recruitment email to each of the potential participants. The recruitment email provided a brief description of the study and a link to the consent form (Appendix H). Participants who agreed to volunteer for the study by filling out the consent form were randomly assigned to one of the two groups and issued a unique identification number for anonymity of data.

Research Procedures

After using convenience sampling to recruit participants, each participant was given a unique ID number to assure anonymity and then randomly assigned to either the experimental or control group. Both groups were isolated from any information regarding the judging experience including contact with the local Judge Adviser until after completing the Pre-Training Survey, the training materials, and the Post-Training Survey.

Experimental Group. The researcher conducted the experimental intervention using 18 adult volunteers who could have potentially served as rookie judges at an FRC event. The researcher used an email (Appendix I) to communicate the process through which the volunteers participated in the *FIRST* Robotics: Judges Training Intervention and learned about the background of *FIRST*, the philosophy of *FIRST* regarding awards, the various awards to be judged, and how to best work together with fellow judges in reaching consensus. Before initiating work on the intervention, the participants completed the Pre-Training Survey. Upon the completion of the survey, group members were directed to a link to the intervention at the end of the survey. Participants were required to complete the training over the course of approximately a one-hour period of time. Following completion of the online module, the learners were directed to a link to complete the Post-Training Survey.

Control Group. The control group was comprised of 24 adult volunteers who could have potentially served as rookie judges at an FRC event. The researcher communicated the process to the members of the control group via email (Appendix J) and informed them of their tasks. The email included a link to the Pre-Training Survey. Upon completion of the survey, the members of the control group were directed to a link to access a pdf copy of the Judge Manual and asked to read through the material in a single sitting over the course of approximately a one-hour period of time. At the end of the manual, the control group members found instructions to go online and enter a hyperlink, which led them to the Post-Training Survey.

Data Collection

The researcher used the Pre-Training Survey and the Post-Training Survey to collect data for analysis from the experimental and control group participants who had a signed the Consent Form. Participants were asked to enter the ID number at the start of completing the Pre-Training

(Table 1) and Post-Training Surveys. Each of the surveys was presented to the groups using Google Forms with the data being extracted in the form of a Microsoft Excel spreadsheet. The researcher assigned, anonymous participant ID numbers to match Pre-Training Survey responses with Post-Training Survey responses. When all of the Post-Training Surveys were completed, the data was exported, downloaded, and imported into SPSS for analysis.

Data Analysis

The researcher collated experimental and control data from the Pre-Training and Post-Training Surveys utilizing SPSS software to conduct tests for analysis of covariance (ANCOVA) seeking to identify differentiation in perceived self-efficacy according to the research questions of the study. Survey items on the Pre- and Post-Training Surveys were divided into three groupings of five questions based upon the research questions identified. Each of the fifteen questions was scaled on a 5-point Likert scale: 1 = I cannot do this at all; 2 = I am not sure if I can do this; 3 = I think that I can do this; 4 = I am certain I can do this; and 5 = I am highly certain I can do this. Scores on the Pre-Training Survey served as the covariate with the intervention serving as the independent variable and the scores on the Post-Training Survey as the dependent variable. Quantitative analysis of the data through examination of the results of the ANCOVA testing allowed the researcher to identify if the instructional intervention produced higher levels of perceived self-efficacy, in potential rookie judges over those in the control group on three scales: 1) fulfill role as a judge, 2) understand criteria to assign awards, and 3) collaborate with other judges. For the ANCOVA analysis, overall mean scores from the five questions from each scale were used to identify variances among the participants in the study. These means were then adjusted by the covariate of the scores from the Pre-Training Surveys to isolate for score gains on the Post-Training Survey. By adjusting the means by the covariate, the

reported gains in self-efficacy on the Post-Training Survey purportedly show the effectiveness of the training methodology for the experimental and control groups by taking into consideration preexisting belief structures held by the participant (Hinkle, Wiersma, & Jurs, 2003).

Separate text coding and analysis was conducted on the two open-ended items that followed the Post-Training Survey. These items were as follows: 1) In the space below, please share which aspects of the First Robotics Competition (FRC) Judges training were most helpful in preparing you to be a FRC Judge, and why; and 2) In the space below, please share how the First Robotics Competition (FRC) Judges training could be improved, and why. Each set of answers to the open-ended items was read through many times searching for thematically similar word categories using the constant comparative method of data analysis (Merriam, 2002). The thematically coded word categories were identified through open coding, a creative process of grouping that allowed for a filtering of the data and recognition of broadly recognized patterns for understanding.

Table 1

Research Question by Data Source: Pre- and Post-Training Survey Items

Research Question	**Pre-and Post-Training Survey Items** Directions: … rate how certain you are that you can fulfill the listed judging tasks and responsibilities. Scale: 1 = I cannot do this at all; 2 = I am not sure if I can do this; 3 = I think I can do this; 4 = I am certain that I can do this; 5 = I am highly certain that I can do this.
1. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, ***affect the self-efficacy*** of potential volunteer first-time academic competition judges ***to fulfill their role as a judge*** after controlling for initial self-efficacy?	Function in the role as a judge at a FIRST Robotics Competition.
	Distinguish between the awards at a FIRST Robotics Competition.
	Perform as a judge at a FIRST Robotics Competition.
	Fulfill the responsibilities as a judge at a FIRST Robotics Competition.
	Work as a judge at a FIRST Robotics Competition.
2. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, ***affect the self-efficacy*** of potential volunteer first-time academic competition judges ***to understand criteria to assign awards*** after controlling for initial self-efficacy?	Differentiate between the three major categories of awards.
	Understand the nature of the different awards in each category.
	Analyze the judging criteria used to assign the various awards.
	Determine when a project should receive an award.
	Explain the processes on how to assign the awards.
3. To what extent does completion of an interactive, online training module, as compared to completion of a training manual, ***affect the self-efficacy*** of potential volunteer first-time academic competition judges ***to collaborate with other volunteer academic competition judges*** after controlling for initial self-efficacy?	Collaborate with other judges.
	Voice my opinion when working with judges during the deliberation of awards.
	Listen to other judges and work together to achieve consensus of award winners.
	Let others challenge my opinions while continuing to work with the group.
	Share the responsibility of assigning value to work with others.

Delimitations

Delimitations within the design exist to control for predictable variances. This study restricted the data gathering process to only use those inexperienced judges who were within the United States. Though inexperienced judges from other countries may use the intervention in the future, by controlling for the nation of origin in this study, the researcher attempted to minimize the possibility of differences in culture and language.

A second delimitation used by the researcher was in only using inexperienced judges who could potentially judge awards based upon machine attributes and those potentially judging for awards based upon team attributes. A third classification of judging roles existed for FRC events, but veteran judges usually filled these positions. Although it was possible for an inexperienced judge to participate in such a role, it was quite rare; therefore, the intervention did not delve as deeply into those roles as the others.

Limitations

This quantitative, quasi-experimental, Pre-Test-Post-Test non-equivalent control group design study made every effort to limit the threats to internal and external validity. Limitations exist however in the study that must be addressed. First, the sample size of 42 participants in the study was not ideal due to the time frame in which the study was implemented, to the selective nature of the study being a field of interest within a STEM related field, and due to the hour and a half anticipated time frame potential participants were going to have to voluntarily give for being a part of the study. Additionally, the study used participants recruited by a Judge Adviser and those recommended as potential judges. These individuals had shown to be motivated through their willingness to volunteer; therefore, results may not be generalizable outside of the specific context.

Another limitation was the study measured for a potential increase in participants' reported self-efficacy to work with others. Results may be affected by the unique personality of the individual and how introverted or extroverted they are, by their ability to analyze their own skills.

Finally, the intervention called for a certain degree of computer proficiency and sustained Internet access in order to complete the training. If the sampling pulled in individuals who lacked the skills or sustained access, then the results could be affected.

Biases

The researcher had to be aware of the following potential biases:

1. The researcher had an extensive amount of time invested in the creation of the instructional intervention.

2. The researcher had over two years of experience working as a judge within the Arkansas *FIRST* organization.

3. The researcher worked as a mentor for a local *FIRST* team.

4. The researcher had an interest in publishing the data in the form of a dissertation to meet the graduate requirements of a doctoral degree from the University of Memphis.

5. The researcher could potentially market the instructional intervention to *FIRST* for use with future rookie judge training in exchange for financial compensation.

Chapter 4 Results

Introduction

The data analyses were conducted to examine the comparative change in reported self-efficacy when using an interactive, online training module to teach volunteers as opposed to informal handbook training. This chapter discusses results of the one-way analysis of covariance (ANCOVA) tests conducted as associated with the three research questions for this study.

Research Question 1

The study sought to examine the following research question: to what extent does completion of an interactive, online training module, as compared to completion of a training manual affect the self-efficacy of potential volunteer first-time academic competition judges to fulfill their role as a judge after controlling for initial self-efficacy? To address this question an analysis of covariance (ANCOVA) was conducted. Prior to conducting ANCOVA, an inspection of the data using boxplots was conducted. This revealed no extreme scores or outliers (Figure 2).

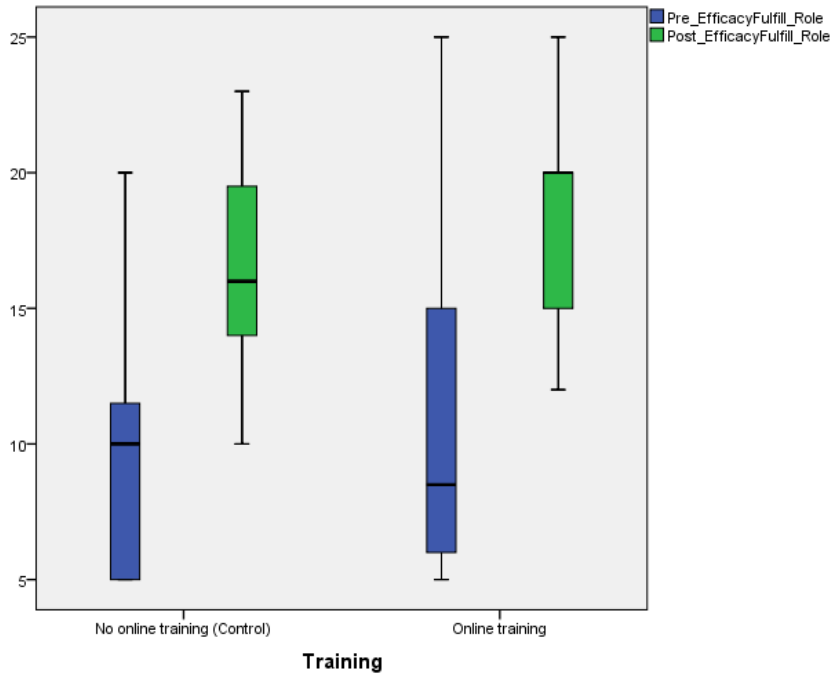

Figure 2. Boxplot of self-efficacy to fulfill role scores.

The data were also analyzed to test the assumptions of normal distribution, linear relationship between the outcome variable and the covariate, equality of variances and homogeneity of regression slopes. Results of the Shapiro-Wilk test revealed that the assumption of normal distribution was met for the Post-Test for both the control group $W(24) = .974$, $p = .77$ as well as the experimental group $W(18) = .931$, $p = .200$. However, there were violations to this assumption for the Pre-Test for both the control group $W(24) = .881$, $p = .009$ as well as the experimental group $W(18) = .842$, $p = .006$. Despite these violations, ANCOVA was considered appropriate because it is robust to violations of this assumption (Morgan, Leech, Gloeckner, & Barrett, 2011). Additionally, Levene's test results revealed that the assumption of homogeneity of variance was met $F(1, 40) = .67$, $p = .419$. Furthermore, an initial ANCOVA analysis was conducted to test the assumption of homogeneity of regression slopes which was also met $F(1, 38) = .20$, $p = .887$. Finally, an inspection of scatterplots (Figure 3) revealed linear relationship between the Pre-Test self-efficacy of fulfilling role scores (covariate) and Post-Test self-efficacy of fulfilling role scores (outcome) across both the experimental group and the control group.

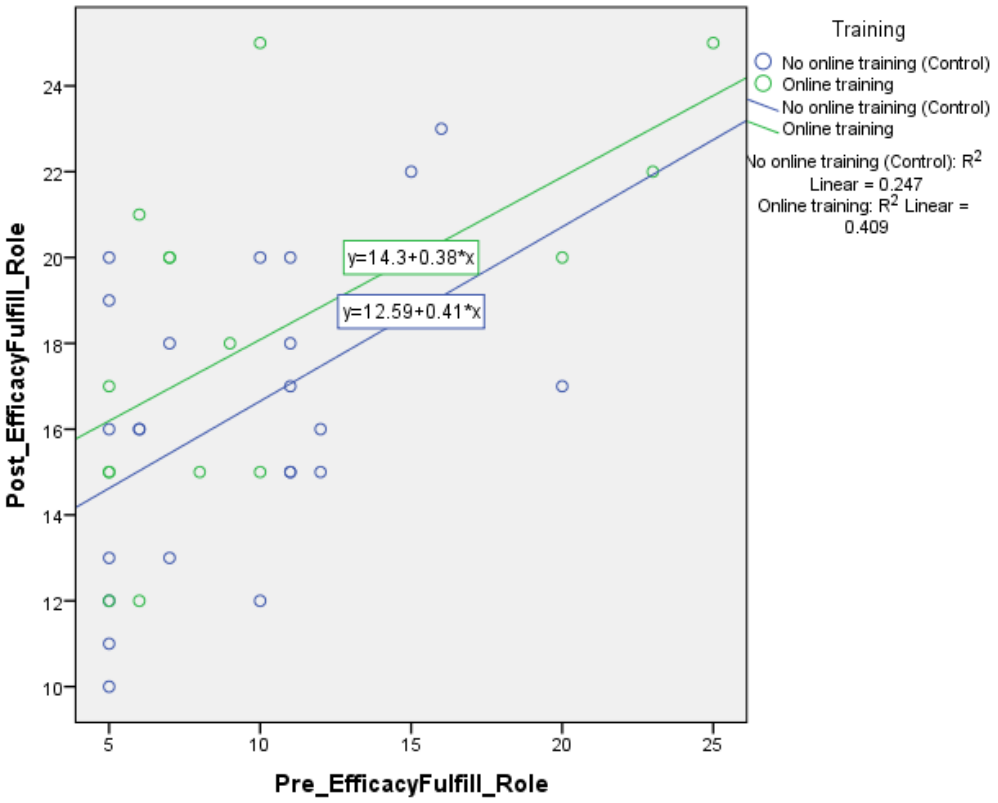

Figure 3. Scatterplot of fulfilling role scores for experimental and control groups.

ANCOVA results revealed that the Pre-Test self-efficacy scores were a statistically significant covariate $F(1, 39) = 18.66$, $p < .001$. However, training method did not have a statistically significant effect on self-efficacy to fulfill role scores after controlling for Pre-Test scores $F(1, 39) = 2.25$, $p = .142$, $\eta^2 = .06$ which constituted a small effect size (Cohen, 1988). Table 2 presents descriptive statistics for self-efficacy to fulfill role for both the experimental group and the control group.

Table 2

Means, Adjusted Means, Standard Deviations and Standard Errors for Self-Efficacy to Fulfill Role: Pre-Test and Post-Test

	Pre-Test		Post-Test	
Group	*M* (*SD*)	*SE*	*M* (*SD*)	M_{adj} (*SE*)
Online Training	10.94 (6.50)	1.53	18.44 (3.85)	18.11 (0.72)
Control	9.42 (4.52)	0.87	16.42 (3.48)	16.67 (0.62)

These results suggest that despite differences in the sample group means, training method (online training module versus training manual) does not have a statistically significant effect on the self-efficacy of potential competition judges to fulfill their role, after controlling for pre-training self-efficacy. It is worth noting however, that the increase in median scores for the treatment group displayed a difference, though not one that is statistically significant enough for generalization.

Research Question 2

The second research question examined was: To what extent does completion of an interactive, online training module, as compared to completion of a training manual affect the self-efficacy of potential volunteer first-time academic competition judges to understand criteria to assign awards after controlling for initial self-efficacy?

To address this, question an analysis of covariance (ANCOVA) was completed. Prior to conducting ANCOVA, an inspection of the data using boxplots revealed no extreme scores or outliers (Figure 4).

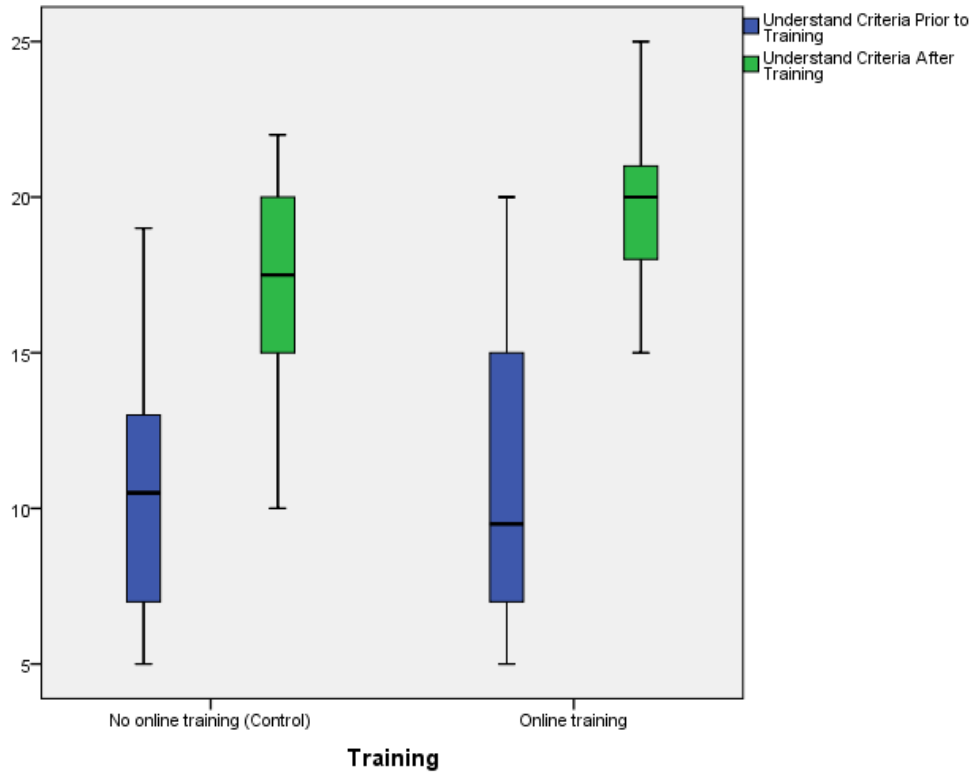

Figure 4. Boxplot of self-efficacy to understand criteria to assign awards.

The data were also analyzed to test the assumptions of normal distribution, linear relationship between the outcome variable and the covariate, equality of variances and homogeneity of regression slopes. Results of Shapiro-Wilk test revealed that the assumption of normal distribution was met for the Pre-Test for both the control group $W(24) = .937$, $p = .140$ as well as the experimental group $W(18) = .921$, $p = .131$. The assumption of normal distribution was also met for the Post-Test for both the control group $W(24) = .959$, $p = .426$ and the experimental group $W(18) = .967$, $p = .730$. Additionally, Levene's test results revealed that the assumption of homogeneity of variance was met $F(1, 40) = .67$, $p = .419$. Furthermore, an initial ANCOVA analysis was conducted to test the assumption of homogeneity of regression slopes, which was also met $F(1, 38) = 2.96$, $p = .094$. Finally, an inspection of scatterplots (Figure 5) revealed linear relationship between the Pre-Test self-efficacy (covariate) and Post-Test self-

efficacy of understanding criteria to assign awards (outcome) across both the experimental group and the control group.

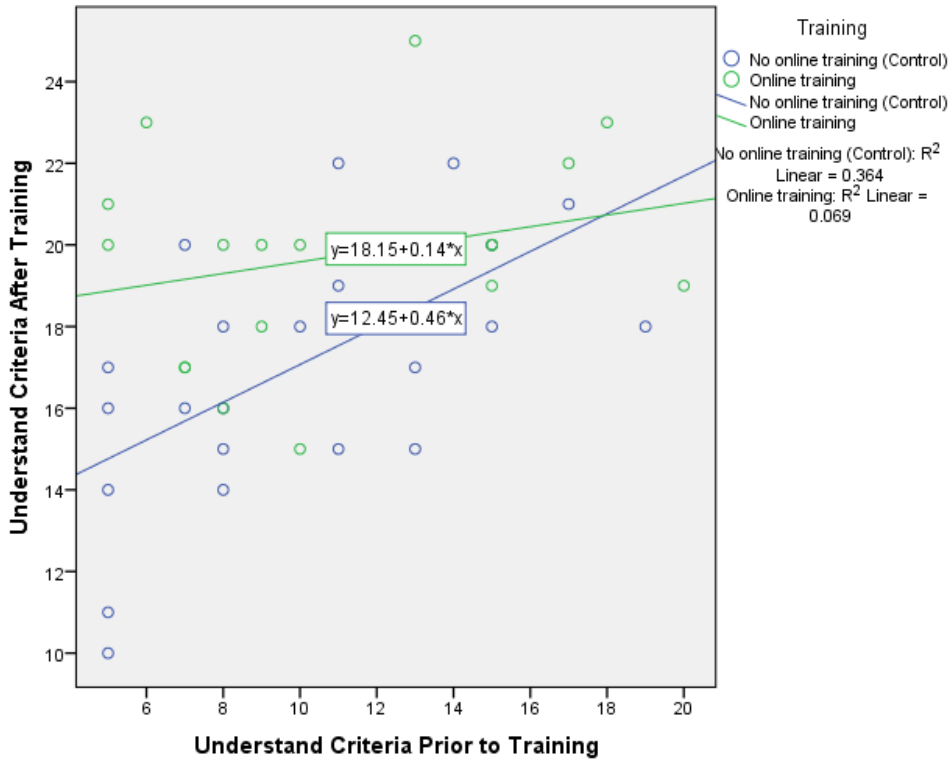

Figure 5. Scatterplot of understanding criteria self-efficacy scores for experimental and control groups.

ANCOVA results revealed that the Pre-Test self-efficacy scores for understanding criteria to assign awards were a statistically significant covariate $F(1, 39) = 10.35$, $p = .003$. Similarly, training method had a statistically significant effect on self-efficacy to understand criteria scores after controlling for Pre-Test scores $F(1, 39) = 8.08$, $p = .007$, $\eta^2 = .172$, which constituted a small effect size (Cohen, 1988). Table 3 presents descriptive statistics for self-efficacy to understand criteria to assign awards for both the online training group and the control group.

Table 3

Means, Adjusted Means, Standard Deviations and Standard Errors for Self-Efficacy Understand Criteria: Pre-Test and Post-Test

	Pre-Test		Post-Test	
Group	*M* (*SD*)	*SE*	*M* (*SD*)	M_{adj} (*SE*)
Online Training	10.94 (4.70)	1.11	19.72 (2.56)	19.59 (0.62)
Control	10.21 (4.11)	0.84	17.17 (3.14)	17.26 (0.54)

These results suggest that training does appear to have an effect on the self-efficacy of potential competition judges to understand the criteria involved in assigning awards, after controlling for pre-training self-efficacy. Furthermore, the magnitude of this effect is also reflected in the large-effect size.

Research Question 3

The third research question for this study was: to what extent does completion of an interactive, online training module, as compared to completion of a training manual affect the self-efficacy of potential volunteer first-time academic completion judges to collaborate with other volunteer academic competition judges after controlling for initial self-efficacy?

To address this, question an analysis of covariance (ANCOVA) was conducted. Prior to conducting ANCOVA, an inspection of the data using boxplots was conducted. This revealed no extreme scores or outliers (Figure 6).

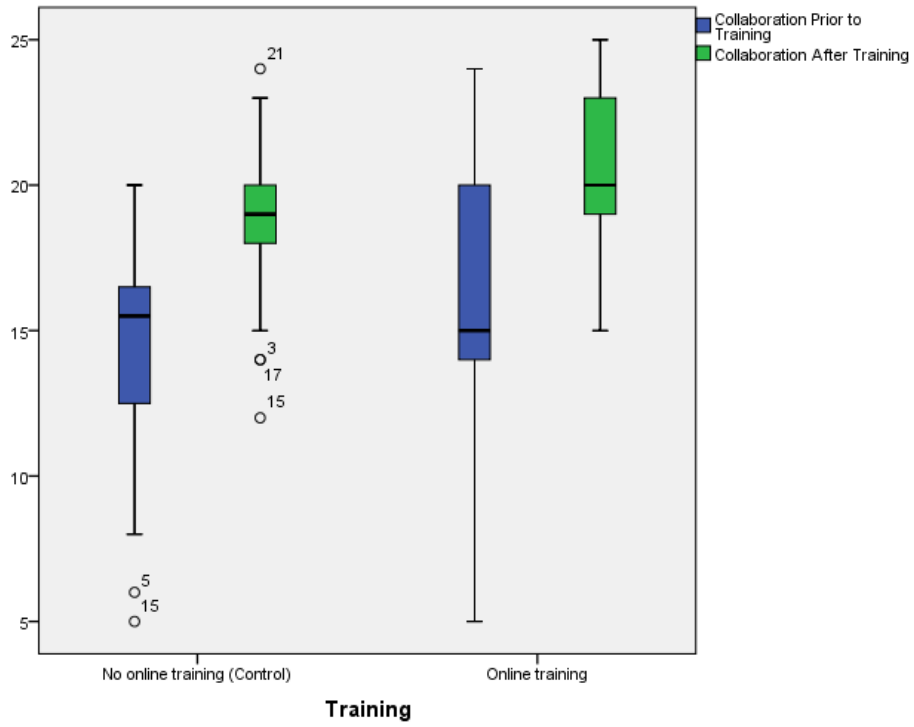

Figure 6. Boxplot of self-efficacy to collaborate with other judges.

The data were also analyzed to test the assumptions of normal distribution, linear relationship between the outcome variable and the covariate, equality of variances and homogeneity of regression slopes. Results of Shapiro-Wilk test revealed that the assumption of normal distribution was met for the Pre-Test for both the control group $W(24) = .924$, $p = .072$ as well as the experimental group $W(18) = .962$, $p = .635$. The assumption of normal distribution was also met for the Post-Test for both the control group $W(24) = .952$, $p = .303$ and the online training group $W(18) = .931$, $p = .203$. Additionally, Levene's test results revealed that the assumption of homogeneity of variance was met $F(1, 40) =. 952$, $p =.335$. Furthermore, an initial ANCOVA analysis was conducted to test the assumption of homogeneity of regression slopes which was also met $F(1, 38) = .065$, $p = .800$. Finally, an inspection of scatterplots (Figure 7) revealed linear relationship between the Pre-Test self-efficacy of fulfilling role scores (covariate)

and Post-Test self-efficacy of collaboration scores (outcome) across both the experimental and the control group.

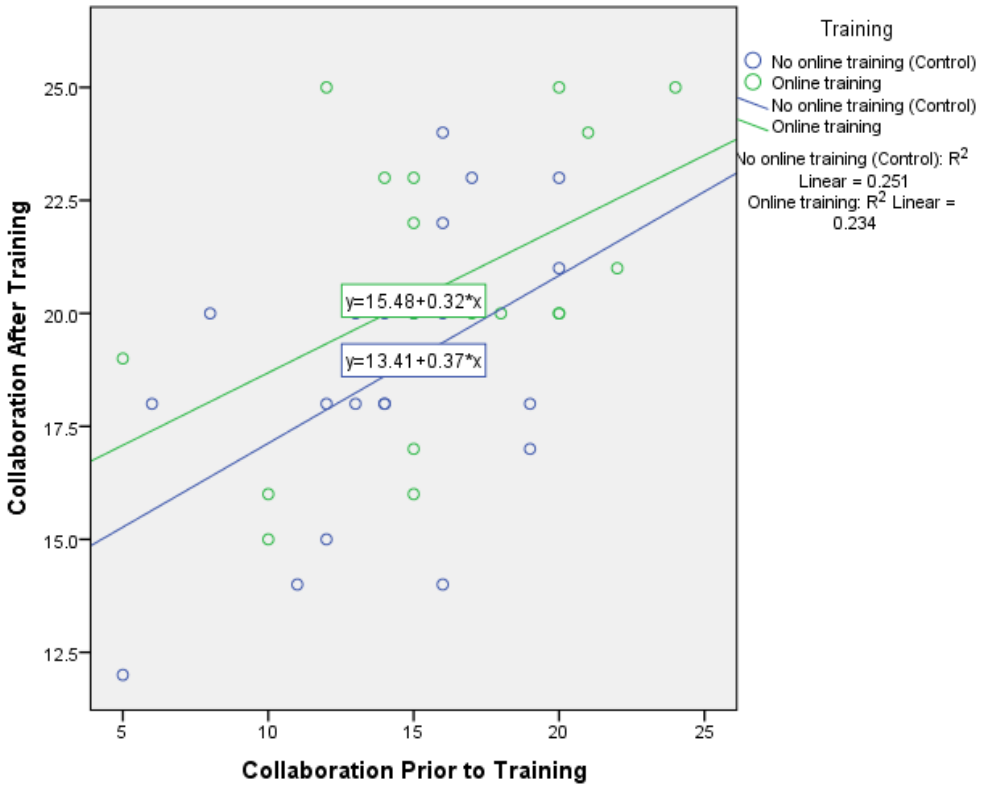

Figure 7. Scatterplot of collaboration self-efficacy scores for experimental and control groups

ANCOVA results revealed that the Pre-Test self-efficacy scores were a statistically significant covariate $F(1, 39) = 12.43$, $p = .001$. However, training method did not have a statistically significant effect on self-efficacy to collaborate with other judges scores after controlling for Pre-Test scores $F(1, 39) = 2.32$, $p = .136$, $\eta^2 = .06$ which constituted a small effect size (Cohen, 1988).. Table 4 presents descriptive statistics for self-efficacy to collaborate with other judges for both the experimental and the control group.

Table 4

Means, Adjusted Means, Standard Deviations and Standard Errors for Self-Efficacy to Fulfill Role: Pre-Test and Post-Test

	Pre-Test		Post-Test	
Group	*M* (*SD*)	*SE*	*M* (*SD*)	M_{adj} (*SE*)
Online Training	16.00 (4.83)	1.14	20.61 (3.20)	20.29 (0.64)
Control	14.38 (3.97)	0.81	18.75 (2.94)	18.99 (0.55)

These results suggest that despite differences in the sample group means, training method (online training module versus training manual) does not appear to have an effect on the self-efficacy of potential competition judges to collaborate with other judges in the assignment of award, after controlling for pre-training self-efficacy. It is again worth noting however, that the increase in median scores for the treatment group displayed a difference as well, though not one that is statistically significant enough for generalization.

Subjective data

At the end of the Post-Test for both the experimental group and the control group, participants were asked two open-ended questions: 1) "…which aspects of the First Robotics Competition (FRC) Judges training were most helpful in preparing you to be a FRC Judge, and why?" and 2) "…share how the First Robotics Competition (FRC) Judges training could be improved, and why?" Through open coding of the data and categorizing the concepts into thematically similar structures, the open ended questions revealed several important understandings from the participants.

Most helpful aspect of training. Responses regarding participant perceptions of the most helpful aspects of the judges training are first presented by the experimental group, and then followed by the control group.

Experimental group. The 18 responding participants from the experimental group were able to enter more than one response if they so chose. Analysis of the experimental group responses regarding elements most helpful to preparation revealed three themes: 1) user friendliness of the online module, 2) appreciation for the videos as an aid to the instruction, and 3) the specificity of the training for the role. Three participants in the experimental group found the ease of use and welcoming nature of the online module to be a significant feature. Comments from the respondents such as "*Content was presented in a simple clear and concise format. I was not overwhelmed with pages of text. I liked how the information was broken up into sections with quizzes at the end to provide me with immediate feedback*," were typical of this thematic element regarding the online instruction. Eight comments, the largest number of the themed elements found the videos to be the most helpful element with statements such as "[*I like] the videos because they gave a visual aid and made some of the foreign concepts easier to understand*," and "*The video training because it is more hands on and you can see what you would be doing*." Finally, six responses found the specific nature of the online module to be most helpful with comments such as "*Very clear wording and descriptions*," and "[*I liked] identifying the different categories with examples of what to look for in the participants*."

Control group. The 24 responding participants from the control group were also able to enter more than one response if they so chose. Analysis of the control group responses regarding elements most helpful to preparation revealed three themes: 1) clarity and specificity of the manual, 2) reassurances in the manual to the new judges, and 3) organizational structure of the

manual. Overwhelmingly, the participants in the control group found the clarity and specificity of the manual to be the most helpful element with 21 of the 24 identifying this feature. Comments from the respondents such as "*I appreciated the bullet points that outlined the criteria for each award*," and "*The awards section was well written and easy to understand. The criteria were detailed and the rules were simply explained,*" were typical of how the participants felt about the manual. Three comments found the manual to be comforting in its reassurance to the new judges with statements such as "*What helped me was knowing that there were Judges' Assistants and Judges' Advisors because they are a vital role with helping judges with determining the awards.*" Finally, responses found the organizational structure of the manual to be most helpful with comments such as "*The table of contents definitely makes referring back to the manual when looking up something specific more efficient. It was broken down into a way that was easy to understand*."

How training could be improved. All participants were invited to share how the First Robotics Competition (FRC) Judges training could be improved, and why. Responses are presented by the experimental group and then followed by the control group.

Experimental group. In analyzing the constructive criticism of the online module, only 12 of the 18 participants responded with critical feedback. Of these comments, seven comprised a theme of requesting more specificity with the examples of how each award was to be assigned. Comments were similar in nature to that of a participant who said: "*Possibly giving examples of previous teams that have won and why their team was chosen. It would help to have a point of reference from previous years*." The remaining comments were too widely varied to fit into a thematic pattern with statements such as: "*All videos should be mandatory to ensure understanding*," and "*Overall, Judges training could be improved by lowering the volume of the*

background music in the videos. The content was good, but the music was slightly distracting. The music theme was used to promote excitement, but as mentioned... just a tad too loud." Whereas these comments were constructive to the development of future modules, they lacked cohesiveness and unity for analysis as a group.

Control group. Analysis of the control group responses regarding elements of the training manual they felt needed improvement revealed three themes: 1) detailed examples of what the judges should be looking for in the course of their duties, 2) links to videos that would allow the participant to have a visual experience of the environment, and 3) a limiting of instruction presented due to information overload. Requesting greater use of examples in the training manual, eight participants in the control group mentioned this as a chief concern. Comments from the respondents such as "*It would be nice to have a simulation judging experience. Completing a simulation would give more confidence in my abilities to be an effective judge*," and, "*I could use some visual models/examples in the training manual,*" were common of this thematic element regarding the manual. Three comments mentioned that links to videos would be the most helpful element with statements such as: "*I think that if there was a possible video going more in-depth about the rules in guidelines, would be helpful*," and "*The judges training could be improved by providing a step-by-step video to allow people to have a visual experience of what exactly they will be volunteering for*." Finally, four responses found the manual to be overwhelming with the vast amount of material presented saying things like: "*A clearer difference between the awards, after reading through them after a while, it all started to mesh together,*" and "[*I] found it to be very wordy*."

Results Summary

Two groups of individuals participated in this study to determine the effect on reported self-efficacy between adult volunteers who were trained to be judges for a robotics competition using an interactive, online training module as the experimental group and those in a control group who were trained using a traditional handbook. Data were collected and analyzed using ANCOVA to examine changes in reported self-efficacy using the scores from the Pre-Test as the covariate to control for existing levels of self-efficacy. Inspection of the descriptive statistics indicated that though there were statistical increases in the scores for those trained using the online training method in regards to the participant's self-efficacy to fulfill their roles as judges and collaborate with other judges, these were not statistically significant. The descriptive statistics for the reported self-efficacy of online trainees in their ability to distinguish between the different awards did reveal statistical significance over those participants who were trained using the traditional handbook. Further, following the post survey, participants responded to two open-ended questions that were analyzed for broad themes related to which aspect of the training was most beneficial and how the training could be improved. Participants in the experimental group identified three components of the training as most beneficial: user friendliness of the online module, appreciation for the videos as an aid to the instruction, and the specificity of the training for the role. The control group participants reported the following as the most beneficial aspects of using training manual: clarity and specificity of the manual, reassurances in the manual to the new judges, and organizational structure of the manual. Regarding how training could be improved, the experimental group responses primarily reflected one key theme: more specificity with the examples of how each award was to be assigned. In contrast, the control group reported the following as ways to improve the training manual: add more detailed examples of what the

judges should be looking for in the course of their duties, links to videos that would allow the participant to have a visual experience of the environment, and limiting instruction presented due to information overload. The results from the quantitative elements associated with the three research questions and the results from the qualitative elements associated with the open ended questions and their implications will be discussed further in Chapter Five.

Chapter 5 Discussion and Conclusions

This chapter provides discussion regarding interpretation of the findings, and is organized as follows: 1) Introduction and Summary of the Findings, 2) Discussion of Findings, 3) Implications for Practice, 4) Recommendations for Future Research, and 5) Conclusions.

Introduction and Summary of Findings

The focus of this study was to examine the role of interactive online adult volunteer training as compared to use of a training manual with regard to increasing the self-efficacy of participants to serve as a judge. The participants for this study were recruited using the help of the judge adviser for Arkansas FIRST, an associate member of FIRST, a world-wide organization that provides opportunities for robotics competitions for high school aged students. Participants were also recruited from among individuals not related to the FIRST organization, but who were identified as potential volunteers based upon the recommendations from members of different STEM-related groups. From the pool of recommended individuals, 42 people participated in either the experimental group ($N = 18$) with access to training materials in an interactive, online module, or the control group ($N = 24$) with access to the traditional handbook. The Pre-Test was administered before the training and the Post-test following the training to collect data in order to gain insight on the three research questions. Each of the survey items was pre-identified as being associated with one of the three self-efficacy scales: 1) fulfill role as judge, 2) understand criteria to assign awards, or 3) collaborate with other judges. Below is a summary of the findings as associated with the three self-efficacy scales.

Fulfill Role as Judge

Data from the five Pre- and Post-Survey items were used to assess the self-efficacy of the participant to fulfill their role as a judge. Reported scores from the Pre-Test served as a covariate

in the ANCOVA process. Although the adjusted means of the reported self-efficacy scores were higher for the experimental group (M_{adj} = 18.11, SE = 0.72) than the control group (M_{adj} = 16.67, SE = 0.62), the results of the data only registered as a medium effect (p = .142, η^2 = .06). This suggests that despite the apparent difference in the improvement in scores between the interactive, online module and the traditional handbook, they were not statistically significant.

Understand Criteria to Assign Awards

Scores from the five items related to self-efficacy of the participant to understand criteria to assign awards were asked prior to and following both interventions. Once again, the Pre-Test results served as a covariate in the ANCOVA process. Adjusted means of the reported self-efficacy scores were higher for the experimental group (M_{adj} = 19.59, SE = 0.62) than the control group (M_{adj} = 17.17, SE = 0.54), and the statistical significance registered as a large effect size (p = .007, η^2 = .172). This suggests the use of an interactive, online module has a higher likelihood to be generalizable a larger population for use in training adults to understand the criteria used to assign awards at robotics competitions.

Collaborate with Other Judges

Scores from five items related to the self-efficacy of the participant to collaborate with other judges were asked prior to and following both interventions with the reported scores from the Pre-Test serving as a covariate in the ANCOVA process. Similar to research question one, although adjusted means of reported self-efficacy scores were higher for the experimental group (M_{adj} = 20.29, SE = 0.64) than the control group (M_{adj} = 18.99, SE = 0.55), the significance only registered as a medium effect (p = .136, η^2 = .06). Similar to research question one which dealt with the reported self-efficacy of an adult volunteer to fulfill their role as a judge, the analysis of the data shows that despite the apparent difference in the improvement of scores, the results were

not statistically significant between the groups participating in training through an interactive, online module and the traditional handbook.

Open Ended Responses

In addition to the research questions that were quantitative in nature, two open-ended questions were also asked of the participants regarding which element of the training was the most helpful in their preparation to be a judge and how could the training have been improved. Responses were thematically analyzed revealing commonalities in responses between the individuals who participated in the control and experimental groups. Analysis showed that the participants in the control group liked the clarity and structure of the manual and the reassurances in the manual to the new judges while participants in the experimental group overwhelmingly favored the use of videos in the instruction. Analysis of the responses for how to improve the instruction saw the control group requesting video elements to add a visual element to their learning in addition to a greater number of tangible examples for the furtherance of their understanding of the judging role while the experimental group also requested specific examples of the awards recipients to have a better grasp of their job.

Discussion of Findings

There exists a need for the training of adult volunteers in order to increase their comfort with the roles assigned and the confidence that they have in the nature of performing their role (Pomeroy & Parrish, 2013). Research suggests use of e-learning is an effective method to achieve training goals for adults. Specifically, interactive, online environments allows for learning to occur any time and any place (Chen, & Yeh, 2008); learning to occur at the learner's pace and around the learner's schedule (Jézégou, 2013); and learning to be group oriented while conforming to an individual's needs of time, location and learning style (Liaw, 2008;

Magnussen, 2008; Rhode, 2009; Sun, et al., 2008). The findings of the current study provide insight into the role of two types of training, interactive online versus training manual, with regard to affecting the self-efficacy of potential volunteer first-time academic competition judges.

The premise underlying this research was that the self-efficacy of the online participants would increase more than that of participants in the control group due to specific features of the interactive online training, such as vicarious experiences, feedback, and use of video. For example, vicarious experiences were provided by providing scenarios in the training that a judge would go through during the interviewing of students and the collaboration that would occur with other judges during the deliberation process. Feedback was given to the participant through the use of formative assessments allowing for immediate updates to the learner's understanding of the information provided. Videos were used to demonstrate the capabilities of robots from previous years allowing the potential judge to have an idea of the high level of engineering skill demonstrated in the competitions. Bandura (1996) suggests that learning experiences involving such vicarious experiences contribute to improved self-efficacy. Pomeroy and Parrish (2013) found correlation between receiving training and an increase in the levels of self-efficacy of volunteers after the training, but how that training was delivered would affect the results. For example, in their meta-analysis of 27 studies with over 5,501 participants, Ashford, Edmunds, and French (2010) found that the vicarious experiences and feedback techniques produced the highest gains in self-efficacy for participants in the studies. Regarding use of video, Choi and Johnson (2005) found use of video in online learning to be more relatable, more memorable, and caused a greater attention to detail. This section presents a discussion of the findings associated with each research question as interpreted and supported with relevant literature

Research Question 1

> *To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to fulfill their role as a judge after controlling for initial self-efficacy?*

The purpose of Research Question 1 was to gain an understanding of participants reported self-efficacy to fulfill their role as a judge after completing an interactive online training program or a traditional, non-interactive training manual, using the Pre-Test as a control for initial self-efficacy. Written and organized by the two Chief Judge Advisers in collaboration with veteran judges with many years of experience, the non-interactive training manual laid out a sequential and clear description of the process involved in being a judge including a timeline of events, a short breakdown of each individual award, and an explanation of the underlying methodology and purpose of the award structures provided during competitions. According to the concepts involved with Cognitive Load Theory, learners often feel bombarded with an overwhelming amount of information when presented with a new and/or novel situation (Sweller, 2011; Tergan, 2005; Kayama & Okamoto, 2001; Miller & Miller, 1999; Sweller, 1994). The interactive online training module was intentionally designed to minimize cognitive overload by sequencing information in short manageable chunks while providing an ecosystem of navigation that allowed for the learner to know their progress along the instructional delivery. It showed through the used of videos the advanced capabilities of the robots they would be judging and gave them immediate feedback from multiple formative assessments placed after each section of learning. These elements were designed to assist learners to feel confident in their understanding of how to be a judge and secure that they could fulfill their role. However, the outcomes of this study did not align with studies (Breso, Schaufeli, & Salanova, 2011; Fletcher,

2005) in that they did not suggest significant difference between the experimental and control group reported self-efficacy to fulfill the role of a judge. It is possible that the reported self-efficacy of fulfilling the role of a judge is less a construct of the training as it is an innate component of the individual's measure of their capabilities. As Bandura expanded in his literature on Social Learning Theory (1996), self-efficacy may be increased through a variety of means such as mastery of tasks, vicarious experiences, and emotional desire. It would be logical to assume then that if the learner did not feel that they had mastered the task, didn't connect with the presented vicarious experiences, or did not have a change in their emotional desire to fulfill their role as a judge, their reported self-efficacy scores would not increase. Examples of the lack of connection with the experience can possibly be found in the open-ended survey questions where participants in both groups reported a desire for more specific images of the robots being judged and examples of previous winners with a list of why they won. As such, a change in training modality might have little to no effect on final reported variance between the Pre- and Post-Test questions.

Research Question 2

> *To what extent does completion of an interactive, online training module, as compared to completion of a training manual, affect the self-efficacy of potential volunteer first-time academic competition judges to understand criteria to assign awards after controlling for initial self-efficacy?*

The key focus of Research Question 2 was to gain an understanding of participants reported self-efficacy to understand criteria used to assign awards after completing an interactive online training program or a traditional, non-interactive training manual, using the Pre-Test as a control for initial self-efficacy. The outcomes of this study did align with previously mentioned studies in that there was a significant difference between the experimental and control group

reported self-efficacy to understand the criteria used to assign awards. The use of videos to describe the experiences of the judges and their working environment seemed to create a more relational vicarious experience with the participants of the experimental group. This was supported in the open-ended data with such statements as "*The videos gave a visual aid and made some of the foreign concepts easier to understand,*" and "*The combination of short videos and short sentences/paragraphs on individuals slides were effective*." This positive reaction to use of the videos supports the study of Kay and Kletskin (2012), which found videos to be an aid to the self-efficacy of the learner. During the course of designing the instrument, much consideration was given to the specific nature of content in the videos presented. The videos used in the experimental group were intentionally kept at a broad-based, big picture level of the experience judges might interact when working at a regional competition. They were presented with the goal of creating a vicarious experience for the judge to be able to connect with their responsibilities without creating a significant difference between the two training modalities. There appeared to be a difference between understanding the criteria for the awards of a specific organization to which the individual has no previous experience and the self-efficacy involved in fulfilling a role as a judge. Because the awards are specific to an organization, in this case FIRST robotics, it would be logical to assume this question to be more subject to the variances in modalities of training thus fitting in more closely with the metadata study of Ashford, Edmonds, and French (2010) showing significant variance between modalities of instruction affecting reported self-efficacy of over 5,500 participants across 27 studies.

Research Question 3

> *To what extent does completion of an interactive, online training module, as compared to completion of a training manual affect the self-efficacy of potential volunteer first-time academic completion judges to collaborate with other volunteer academic competition judges after controlling for initial self-efficacy?*

The purpose of Research Question 3 was to gain an understanding of participants reported self-efficacy to collaborate with other judges after completing an interactive online training program or a traditional, non-interactive training manual, using the Pre-Test as a control for initial self-efficacy. Similar to the results of Research Question 1, the outcomes of this study did not align with studies showing significant increase in reported self-efficacy in that there was no significant difference between the experimental and control group reported self-efficacy to collaborate with other judges. Collaboration and volunteering are both social activities involving the interaction between individuals (Foley & Smeaton, 2010; Allen & Shaw, 2009; Cravens, 2006; Allison, Okun, & Dutridge, 2002; Clary et. al., 1998). This similarity between the two constructs of collaboration and volunteerism could lead to the possibility that the nature of an individual willing to volunteer would already posses the belief structure towards a positive self-efficacy to collaborate with others. Further, in many science fairs and academic competitions, judges of the events are college faculty, researchers, and graduate students (Sahin, 2013). FIRST desires as well that it's judges "have an appropriate level of education and/or real-world experience," (FIRST, 2017, p. 11). The implication is that they would have an academic or professional level of proficiency to explore and award technical awards. Recognizing that the potential judges in both groups may have volunteered to judge a STEM related, academic area, it is possible that there would not be significant difference in reported self-efficacy to collaborate with others due to a pre-existing substantive level of assurance that they could work well with others in order to collaborate together for the purposes of assigning awards. As such, a variance in training modality might have little to no effect on final reported variance between the training from an interactive, online training and a traditional handbook.

Implications for Practice

In the local context of Arkansas FIRST and the training of judges for the FRC event, this study shows the need for the development and implementation of an interactive, online training module to be used with new volunteers preparing to be rookie judges. The study showed that there are statistically significant gains made for individuals to be able to distinguish between the various awards having participated in the online module. Although the study did not show that the gains made for the other two research questions were statistically significant for generalization to the larger population, the study did show gains for of a medium effect in both questions that could prove to be significant with a larger research population.

In the larger context, this study suggests that online instructional modules may be a viable and productive tool to use in the training and integration of adult learners into their respective roles as volunteers. Volunteers are shown to be such a valuable resource (Salamon, Sokolowski, & Haddock, 2011; Bovaird, 2007; Joshi & Moore, 2006) that efforts should be taken to maximize their training. The study reveals promising outcomes in that the judges felt that they could more adequately perform their role as a judge to assign awards when having been trained in an interactive, online environment. Therefore, use of such training methods should prove worthwhile for development by other entities whose success relies so heavily on adult volunteers.

Recommendations for Future Research

Although this study revealed significant outcomes regarding improved self-efficacy of potential volunteers to distinguish between awards, it is recommended that future research explore this topic with a larger sample size to increase generalizability to larger populations. It is also recommended that the research be conducted using more individuals who have already

volunteered to participate in the FIRST program as judges so as to decrease the numbers of individuals who would be unwilling to commit the time to partake in the study and to increase the likelihood that the results would be generalizable to that particular population as opposed to a wider grouping of potential volunteers. Second, the results from the Post-Test reveal data following the intervention, but prior to the volunteer actually serving as a judge at a FIRST event. It is recommended that future follow-up research be conducted to ascertain perceptions from the experimental and control groups in a hindsight environment giving potentially greater and more specific insight into whether or not reported self-efficacy would be affected following the actual experience of having served as a judge. Not only would this provide potentially greater insight into the experience of being a judge having participated in the training, it could strengthen the case for the use of interactive, online training within the FIRST community with application to a larger context as well. Third, future research is needed to identify potential differences between demographic groups; especially with a focus on professional and experiential background. As the judges are volunteers from a wide variety of backgrounds either inside or out of the STEM culture, it is recommended to study if isolated results based upon profession and experience as covariates, would significantly affect the reported self-efficacy of participants. Finally, according to the information gleaned from the Post-Test open-ended response questions, giving specific examples of award recipients from tournaments conducted in previous years was listed as a potential benefit to improving the online module. It is recommended that the module be refined and expanded to show images of previous award-winning robot designs so that the rookie judges can have a clearer understanding of what they are to be looking for as they seek to distribute the awards to the most deserving candidates.

Conclusions

The purpose of this study was to examine the effect of reported self-efficacy by training adults using an interactive, online module in comparison to a traditional handbook. Though results indicated a higher level in reported self-efficacy for the volunteer's ability to fulfill their role as a judge and collaborate with others when receiving their training through the online module, it was not statistically significant enough for the results to be generalized to other adult volunteers. Further studies with larger sample sizes are needed to identify the potential benefits of using online instructional modules in regards to these two questions.

Based on the results of the reported self-efficacy of volunteers who were trained using the online module, there was a statistically significant difference in comparison to those who used the traditional handbook as their training methodology. Because of this significance, it can be generalized that the use of an interactive, online training module does improve the belief of adult volunteers that they can identify and distinguish between the various awards at a robotics tournament over those who received training from a traditional handbook. With the need to train adults judging as volunteers in a manner that best meets the needs of adult learners and gives the volunteers and increased level of certainty that they can perform the tasks to which they have been assigned, this study gives insight that should provide an incentive for using such online modules to better train volunteers for future robotics tournament.

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Appendix A

FIRST Robotics: Judges Training Intervention

https://todtraughber.github.io/#1

Appendix B

2017 FIRST Robotics Competition: Judge Manual

https://drive.google.com/file/d/1rEjev5QZtWLZympc8_To4xBDu2fXTrbj/view?usp=sharing

Appendix C

Pre- Training Survey

https://goo.gl/forms/251wvBVtU3ZEzkxR2

Study ID: _____(Enter study ID issued with your recruitment email)

Directions: Use the scale provided with each item below to rate your degree of confidence in your ability to perform the following judging tasks and responsibilities.

Judging Tasks and Responsibilities	I cannot do this at all 1	I am not sure if I can do this 2	I think I can do this 3	I am certain I can do this 4	I am highly certain I can do this 5
1. Function in the role as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
2. Distinguish between the awards at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
3. Perform as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
4. Fulfill the responsibilities as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
5. Work as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
6. Differentiate between the three major categories of awards.	☐	☐	☐	☐	☐
7. Understand the nature of the different awards in each category.	☐	☐	☐	☐	☐
8. Analyze the judging criteria used to assign the various awards.	☐	☐	☐	☐	☐
9. Determine when a project should receive an award.	☐	☐	☐	☐	☐
10. Explain the processes on how to assign the awards.	☐	☐	☐	☐	☐
11. Collaborate with other judges.	☐	☐	☐	☐	☐
12. Voice my opinion when working with judges during the deliberation of awards.	☐	☐	☐	☐	☐
13. Listen to other judges and work together to achieve consensus of award winners.	☐	☐	☐	☐	☐
14. Let others challenge my opinions while continuing to work with the group.	☐	☐	☐	☐	☐
15. Share the responsibility of assigning value to work with others.	☐	☐	☐	☐	☐

Appendix D

Post-Training Survey

https://goo.gl/forms/uhoLWTe5WRhrMRH62

Study ID: _____(Enter study ID issued with your recruitment email) **Directions**: Now that you have completed the training, please use the scale provided with each item below to rate your degree of confidence in your ability to perform the following judging tasks and responsibilities.

Judging Tasks and Responsibilities	I cannot do this at all 1	I am not sure if I can do this 2	I think I can do this 3	I am certain I can do this 4	I am highly certain I can do this 5
1. Function in the role as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
2. Distinguish between the awards at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
3. Perform as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
4. Fulfill the responsibilities as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
5. Work as a judge at a FIRST Robotics Competition.	☐	☐	☐	☐	☐
6. Differentiate between the three major categories of awards.	☐	☐	☐	☐	☐
7. Understand the nature of the different awards in each category.	☐	☐	☐	☐	☐
8. Analyze the judging criteria used to assign the various awards.	☐	☐	☐	☐	☐
9. Determine when a project should receive an award.	☐	☐	☐	☐	☐
10. Explain the processes on how to assign the awards.	☐	☐	☐	☐	☐
11. Collaborate with other judges.	☐	☐	☐	☐	☐
12. Voice my opinion when working with judges during the deliberation of awards.	☐	☐	☐	☐	☐
13. Listen to other judges and work together to achieve consensus of award winners.	☐	☐	☐	☐	☐
14. Let others challenge my opinions while continuing to work with the group.	☐	☐	☐	☐	☐
15. Share the responsibility of assigning value to work with others.	☐	☐	☐	☐	☐

Open-Ended Items

In the space below, please share which aspects of the First Robotics Competition (FRC) Judges training were most helpful in preparing you to be a FRC Judge, and why.

In the space below, please share how the First Robotics Competition (FRC) Judges training could be improved, and why.

Appendix E

IRB Approval

PRO-FY2018-456 - Initial: Approval - Exempt

irb@memphis.edu

Thu 3/1/2018 7:45 AM

To: Clif Mims (clifmims) <clifmims@memphis.edu>; Deborah Lowther (dlowther) <dlowther@memphis.edu>; Tod Nelson Traughber (tntrghbr) <tntrghbr@memphis.edu>;

Institutional Review Board
Office of Sponsored Programs
University of Memphis
315 Admin Bldg
Memphis, TN 38152-3370

March 1, 2018

PI Name: Tod Traughber
Co-Investigators:
Advisor and/or Co-PI: Deborah Lowther, Clif Mims
Submission Type: Initial
Title: TRAINING ADULT VOLUNTEERS TO JUDGE IN COMPETITIVE, NON-TRADITIONAL EDUCATIONAL ENVIRONMENTS USING ONLINE LEARNING
IRB ID : #PRO-FY2018-456
Exempt Approval: February 28, 2018

Approval of this project is given with the following obligations:

1. When the project is finished or terminated, a completion form must be submitted.

2. No change may be made in the approved protocol without prior board approval.

3. Exempt approval are considered to have no expiration date and no further review is necessary unless the protocol needs modification.

Thank you,
James P. Whelan, Ph.D.
Institutional Review Board Chair
The University of Memphis.

Appendix F

Participant Referral Email

To whom It May Concern,

My name is Tod Traughber and I am pursuing research towards my doctoral degree by learning about training judges to participate in a FIRST Robotics Competition. I am asking you for contact information of individuals who have either volunteered to participate as a rookie judge, or someone you would recommend as a potential rookie judge to participate in my research.

I am asking you for contact information of individuals you would recommend as potential judges to participate in my research. The research process will take approximately two hours to complete. Please reply to this email with the name and email address of those whom you are recommending so that I may communicate with them and get their consent to participate in the research.

Thank you for your willingness to assist in this process.

Most Sincerely,

Tod Traughber

Appendix G

Recruitment Email

To Whom It May Concern,

My name is Tod Traughber and I am pursuing research towards my doctoral degree by learning about training judges to participate in a FIRST Robotics Competition. You have been recommended for this project due to your interest in STEM fields and/or volunteering for FIRST. I am seeking volunteers to participate in my research project, which should take approximately an hour to complete. If you are willing to assist in this project, please click on the link provided to fill out the consent form. After receipt of the consent form, you will be sent an email with a unique ID number, which will provide anonymity for you and the data you provide and a link to the project.

If you have any questions, you may contact me at tntrghbr@memphis.edu.

Sincerely,

Tod Traughber

Link to Consent Form:

https://goo.gl/forms/hdGLUA1hP34ZESee2

Appendix H

Consent Form

THE UNIVERSITY OF MEMPHIS.
Dreamers. Thinkers. Doers.

Institutional Review Board

315 Administration Bldg.
Memphis, TN 38152-3370
Office: 901.678.2705
Fax: 901.678.2199

Consent to Participate in a Research Study

TRAINING ADULT VOLUNTEERS TO JUDGE IN COMPETITIVE, NON-TRADITIONAL EDUCATIONAL ENVIRONMENTS USING ONLINE LEARNING

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

You are being invited to take part in a research study examining two ways to train adult volunteers: online as compared to use of a training manual. You are being invited to take part in this research study because of your potential to act as a judge at a *FIRST* Robotics Competition. If you volunteer to take part in this study, you will be one of about 60 people to do so nationally.

WHO IS DOING THE STUDY?

The person in charge of this study is Tod Traughber of the University of Memphis Department of Instruction and Curriculum Leadership. He is being guided in this research by *Dr. Clif Mims.* There may be other people on the research team assisting at different times during the study.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this research is to compare participant's responses to interactive, online instruction with those from participants who learn through a static training manual. By doing this study, we hope to learn about how using online training methods with adult volunteers can affect their belief in their ability to perform tasks.

ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?

There are no risks associated with this study that might prevent an individual from participation.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

The research procedures will be conducted through online interactions with the lead investigator and through use of a computer for access to training materials. You will be able to access the materials anywhere a connection exists to the Internet. The total amount of time you will be asked to volunteer for this study is approximately three hours over the period of one *week*.

WHAT WILL YOU BE ASKED TO DO?

As a participant in the study, you will be randomly assigned to one of two groups to either read through a PDF training manual about being a FIRST Robotics Competition judge or work through an interactive module online covering the same material. Before and after the training, you will complete a survey regarding your belief in your ability to do certain things related to judging.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

There is less than minimal risk associated with participating in this study.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

There is no guarantee that you will get any benefit from taking part in this study. Your willingness to take part, however, may, in the future, help society as a whole better understand this research topic.

DO YOU HAVE TO TAKE PART IN THE STUDY?

If you decide to take part in the study, it should be because you really want to volunteer. You will not lose any benefits or rights you would normally have if you choose not to volunteer. You can stop at any time during the study and still keep the benefits and rights you had before volunteering.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to be in the study, there are no other choices except not to take part in the study.

THE UNIVERSITY OF MEMPHIS.
Dreamers. Thinkers. Doers.

Institutional Review Board

315 Administration Bldg.
Memphis, TN 38152-3370
Office: 901.678.2705
Fax: 901.678.2199

WHAT WILL IT COST YOU TO PARTICIPATE?

There are no costs associated with taking part in the study.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will not receive any rewards or payment for taking part in the study.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

We will make every effort to keep private all research records that identify you to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private. All stored information will be kept on a single computer that is kept confidential and secure through password protection of both the machine and the folders associated with storing the information. This study is anonymous. Upon completion of this consent form, you will be assigned a unique identification number to keep your information anonymous. That means that no one, not even members of the research team, will know that the information you give came from you.

CAN YOUR TAKING PART IN THE STUDY END EARLY?

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study.

WHAT ABOUT THE DESTRUCTION OF MY INFORMATION?

All information that might link you to this study including data linking you to your identification number and your consent form, will be destroyed following the completion of the study or no later than six months from now.

WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the investigator, Tod Traughber at tntrghbr@memphis.edu or Dr. Clif Mims at clifmims@memphis.edu. If you have any questions about your rights as a volunteer in this research, contact the Institutional Review Board staff at the University of Memphis at 901-678-2705. We will give you a signed copy of this consent form to take with you.

_____ _____
Signature of person agreeing to take part in the study Date

_____
Printed name of person agreeing to take part in the study

_____ _____
Name of [authorized] person obtaining informed consent Date

Appendix I

Communication Email – Experiment Group

Dear Participant,

Thank you for volunteering for the study. You will find at the bottom of this email your Unique ID Number and a link to a Pre-Training Survey. Please use the ID Number when you fill out the surveys before and after the project. Following the first survey, you will be taken to an interactive, online training module that will take approximately 2 hours to complete. Please complete the training from start to finish in one sitting. Following the training, you will be asked to complete the Post-Training Survey.

Your Unique ID Number Is:

Pre-Training Survey Link:
https://goo.gl/forms/251wvBVtU3ZEzkxR2

Thank you again for your willingness to participate.

Sincerely,
Tod Traughber

Appendix J

Communication Email – Control Group

Dear Participant,

Thank you for volunteering for the study. You will find at the bottom of this email your Unique ID Number and a link to a Pre-Training Survey. Please use the ID Number when you fill out the surveys before an after the project. Following the first survey, you will find another link to the Judges Training Manual, which will take approximately 2 hours to complete. You can read the manual from the preview screen or download and read from your computer. Please read through the training from start to finish in one sitting. On the final page of the manual, you will find a link to complete the Post-Training Survey.

Your Unique ID Number Is:

Pre-Training Survey Link:
https://goo.gl/forms/LoorLlCwOVgvfbWk2

Thank you again for your willingness to participate.

Sincerely,
Tod Traughber