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Investigating the Impact of Pre-Professional Organization Participation on Undergraduate Technology and Engineering Education Student Retention and Interest in Teaching

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INVESTIGATING THE IMPACT OF PRE-PROFESSIONAL ORGANIZATION PARTICIPATION ON UNDERGRADUATE TECHNOLOGY AND ENGINEERING EDUCATION STUDENT RETENTION AND INTEREST IN TEACHING

by

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ABSTRACT

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by

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The field of Technology and Engineering Education (TEE) has evolved in name and content throughout its existence. Throughout these evolutions, TEE has struggled to adapt consistently across the United States of America. In addition to these inconsistencies in the field, the number of TEE programs across the United States have decreased along with a decrease in the number of students graduating from TEE

programs. Programs that remain have varying contextual factors including variations in content and the inclusion of industry-track options for program completion.

TEECA, as a community of practice, may influence undergraduate students' interest in teaching and intent to complete their undergraduate TEE program. A Spearman's rho correlation was used to investigate what relationship, if any, existed between TEECA participation and undergraduate students' interest in teaching TEE and their intent to complete their TEE degree. Additionally, a moderation analysis was performed to investigate whether undergraduate students' beliefs about the utility and social contribution of educators, their personal abilities within the TEE content area, and their expectations to do well in the TEE career field has a moderating impact the relationship between TEECA participation and undergraduate students' interest in teaching and intent to complete their undergraduate program.

The study utilized a multiple method approach to further investigate additional aspects of, and experiences gained from, participating in pre-professional communities of practice that undergraduate students recognize as influential in their intentions for their future studies and career. Lastly, this investigation also sought to identify the contextual factors that influence current and potential TEECA members' perception and understanding of the TEE profession through a review of published data and responses from TEE program leaders from varying universities.

Findings revealed no statistically significant relationship between TEECA participation and undergraduate students' interest in teaching and their intent to complete their undergraduate degree. Additionally, no statistical significance was found on the moderating impact of students' beliefs on the relationship between TEECA participation and undergraduate students' interest in teaching as well as their intent to complete their undergraduate degree.

Qualitative data collection and analysis revealed that students recognized TEECA participation as influential in helping them to develop skills and experiences in additional content within TEE. Student responses also indicated a struggle in finding undergraduate TEE programs.

Finally, this investigation showed inconsistency in defining and counting university TEE programs across the United States of America. This inconsistency may contribute to the obstacles students may experience in finding and enrolling in TEE programs.

(200 pages)

PUBLIC ABSTRACT

Investigating the impact of pre-professional organization participation on undergraduate technology and engineering education student retention and interest in teaching

Emily Yoshikawa-Ruesch

The field of Technology and Engineering Education (TEE) has evolved in name and content throughout its existence. Throughout these evolutions, the number of TEE programs across the United States have decreased along with a decrease in the number of students graduating from undergraduate TEE programs. Previous investigations into the recruitment of TEE students have identified social interactions with TEE program faculty and technology and engineering educators as influential in students' interest in teaching technology and engineering at the secondary level. This study sought to investigate how social interactions through participation in Technology and Engineering Educators Association (TEECA), as a community of practice, may influence undergraduate students' interest in teaching and intent to complete their undergraduate TEE program. A Spearman's rho correlation was used to investigate what relationship, if any, existed between TEECA participation and undergraduate students' interest in teaching TEE and intent to complete their TEE degree. Additionally, a moderation analysis was performed

to investigate whether undergraduate students' beliefs about the social contribution of educators as well as the undergraduate students' perceived abilities within the TEE content area have a moderating effect on the relationship between TEECA participation and undergraduate students' interest in teaching and intent to complete their undergraduate program.

The study utilized a multiple method approach to further investigate additional aspects of participating in pre-professional communities of practice that undergraduate students recognize as influential in their intentions for their future studies and career. Lastly, this investigation also sought to identify the contextual factors that influence current and potential TEECA members' perception and understanding of the TEE profession through a review of published data and responses from TEE program leaders from varying universities.

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Qualitative data collection and analysis revealed that students recognized TEECA participation as influential in helping them to develop skills and experiences in additional content within TEE. Student responses also indicated a struggle in finding undergraduate TEE programs.

Finally, this investigation showed inconsistency in defining and counting university TEE programs across the United States of America. This inconsistency may contribute to the obstacles students may experience in finding and enrolling in TEE programs.

DEDICATION

I would like to dedicate this project to my husband and children. You all make life fun and worthwhile. Don't ever feel pressured to read this document, but know you are what got me through writing it.

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This project has taken a village of support that has allowed me to complete this project, and I want to thank every member of that village. Many people have stepped up to help with childcare, making sure my family and I were fed and kept me from becoming a hermit. I would like to especially thank the following.

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CONTENTS

Page

Abstract iii

Public Abstract vi

Dedication ix

Acknowledgments x

List of Tables xvi

List of Figures xviii

Chapter I Introduction 1

- Problem Statement 1
- Purpose of the Study 2
- Research Questions and Hypotheses 3
- Significance 6
- Summary of the Study Procedure 6
- Definitions of Acronyms and Terms 8
- Assumptions 9
- Limitations 10
- Delimitations 10

Chapter II Review of the Literature 12

- Problem Statement 12
- Teacher Shortage 13
  - Current State of Career and Technical Education 15
- Defining TEE and Why We Need It 16
  - TEE Teacher Preparation Undergraduate Programs 20
  - TEECA Participation 24

Theoretical Framework 25

Expectancy-Value Theory 25
Teacher Recruitment within the Expectancy-Value Theory 27
Pre-service Teacher Undergraduate Preparation and Retention 30
Communities of Practice 31

Summary 33

Chapter III Methodology 35

Communities of Practice within the Expectancy-Value Theory 35
Research Design, Population, and Sampling 36

Instrument Development 37

Quantitative Research Questions 38

Quantitative Data Collection 39
Quantitative Data Analysis 43
Quantitative Data Analysis Summary 48

Qualitative Research Questions 49

Influential Student Experiences 50
Contextual Factors of TEE Community 52

Summary 54

Chapter IV Findings 55

Introduction 55
Quantitative Findings 55

Demographics 58
Relationship Between TEECA Participation and Student Intentions 64
Moderation Analysis 66
Statistical Power 71
Additional Findings 72

Influential Student Experiences 73

Demographics 73
Influence of TEECA Participation on Future Interests 76
Benefits of TEECA Participation 77
Undergraduate Program Selection 79
The Greater Good 80

Contextual Factors of TEE Programs 81

Program Synthesis 82
Program Information 85

Summary 89

Chapter V Conclusions and Discussion 91

Introduction 91
Research Question One 95
Research Questions Two and Three 96

Additional Correlations 98

Research Question Four 98

Identified Themes 98

Research Question Five 100

Program Cataloging 101
Current Status of Programs 102
Impact of Type of Undergraduate Program 103

Recommendations for Future Research and Practice 103

Impact of TEECA on Non-teaching Track Students 104
Regional TEECA Participation 105
FIT-Choice Scale 106
TEECA Program Structure 108
Furthering Interviews 109
Recruiting Aspiring Teachers 109
Program Visibility and Recruitment 110
Program Content 112

Summary 112

References 113

Appendix A. Agriculture Education Validation Survey 131

Appendix B. Technology and Engineering Education Survey 146

Appendix C. Interview Protocol 161

General Procedures 162
Interview Script 162

Interview Questions 163
Closure 164

Post Interview Procedures 164

Appendix D. IRB Certificate of Exemption and Informed Consent Documents 165

Curriculum Vitae 170

LIST OF TABLES

Page

Table 1 List of analyses and variables contributing to the analyses 48

Table 2 Codebook used in qualitative analysis 51

Table 3 Demographics of Survey Non-Completers (n = 11) 58

Table 4 Self-described gender (N = 72) 59

Table 5 Year in college the student was completing at the time of completing the survey (N = 72) 60

Table 6 Year in the undergraduate TEE program the student was completing at the time of completing the survey (N = 72) 61

Table 7 Students' interest in teaching (N = 61) 62

Table 8 Student responses to like for teaching (N = 61) 62

Table 9 Students' intentions to graduate from their undergraduate program (N = 61) 63

Table 10 TEECA participation levels (N = 61) 64

Table 11 Crosstabulation of participation level and interest in teaching (N = 61) 65

Table 12 Crosstabulation of participation level and intent to graduate from major (N = 61) 66

Table 13 Rotated exploratory factor analysis results for belief items 68

Table 14 Reliability of original factors and modified factors from the factor analysis 70

Table 15 Spearman’s rho correlation for belief items and students' future intentions 72

Table 16 Interview participant descriptions 74

Table 17 Love and Maiseroulle's (2021) vs NCES comprehensive list of programs 82

Table 18 Status of TEECA affiliation and enrollment numbers 88

LIST OF FIGURES

Page

Figure 1 Expectancy-Value Theory 26

Figure 2 FIT-Choice Scale Model 28

Figure 3 Model of undergraduate student retention through participation in pre-professional organizations 35

Figure 4 Histogram for Participation Level 44

Figure 5 Histogram for Interest in Teaching 45

Figure 6 Histogram for Intentions to Graduate from Major 45

CHAPTER I

INTRODUCTION

Problem Statement

There is growing concern with the decrease in both Technology and Engineering Education (TEE) Programs across the US and, in effect, the number of students graduating as Technology and Engineering educators. The number of bachelor's degrees in TEE awarded by undergraduate teacher preparation programs at the collegiate level dropped from 6,368 awarded in 1975 to 164 awarded in 2017 (Volk, 2019). In the 1970s, there were 203 undergraduate industrial arts and vocational education teacher preparation programs in the United States (Volk, 2019; Herschbach, 1997). This number dropped to 32 by 2018. Of these 32, 14 reported that they were graduating three or fewer students each year (Volk, 2019). These troubling statistics have motivated research regarding the recruitment, retention, and program curriculum around TEE teacher preparation programs (Litowitz, 2014; Love & Love, 2022). Amongst these findings, it was found that face-to-face interactions with technology teachers, TEE alumni, and TEE faculty were the most influential in a student's choice to pursue a TEE degree. Additional findings from studies utilizing the expectancy-value theory found that in-service teachers' beliefs regarding their personal abilities and the social utility of educators impacted their perseverance and motivation as educators.

Given the influence of face-to-face interactions with educators, alumni, and faculty members, a closer look into student recruitment and retention for students involved in a related pre-service collegiate association could prove to be a significant factor in program success in both recruitment, retention, and graduation rates of teachers into the field. The Technology and Engineering Education Collegiate Association (TEECA) is the collegiate association affiliated with the International Technology and Engineering Educator Association (ITEEA) and is the only collegiate association for TEE majors in the nation. Involvement varies heavily from university to university. However, no research currently exists regarding TEECA and its role in the retention of TEE students. It is also unclear how pre-service teachers' beliefs may also impact the relationship between participation in pre-service organizations, such as TEECA, and the retention of students.

In addition to involvement in TEECA varying between university TEE programs, other contextual factors that vary between programs may exist. These contextual factors may influence current and potential TEECA members' perception and understanding of the TEE profession. However, it is unclear what these factors may be. Additional studies may help to clarify these contextual factors surrounding the current state of TEE programs, along with program enrollment, structure, and career preparation.

Purpose of the Study

The purpose of this study was to investigate the impact of participation in TEECA, as a community of practice, on students' decision to complete their TEE teaching degree as well as pursue a career as a TEE educator after graduation from their TEE undergraduate program. Additionally, the study investigated whether undergraduate students' beliefs about the utility and social contribution of their major, their personal abilities within the TEE content area, and their expectations to do well in the TEE career field moderate the relationship between TEECA participation and the student's future interests and intentions. The study also sought to identify additional aspects of, and experiences gained from, participating in pre-professional communities of practice that undergraduate students recognize as influential in their intentions for their future studies and careers. Lastly, this investigation also sought to identify the contextual factors that influence current and potential TEECA members' perception and understanding of the TEE profession.

Research Questions and Hypotheses

To guide this research, the following research questions and hypotheses were developed.

1. What relationship, if any, exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and their:

   a. Interest in teaching technology and engineering as a future career?
      i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the interest in teaching as a future career.
   b. Intent to complete their undergraduate TEE program?
      i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the intention to continue in the undergraduate TEE program.
2. Is the effect of participation in TEECA on an undergraduate TEE student's interest in pursuing teaching as a future career moderated by:
   a. Ability beliefs?
      i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.
   b. Expectancy beliefs?
      i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.
   c. Utility beliefs?

        i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

3. Is the effect of participation in TEECA on an undergraduate TEE student's interest in completing their undergraduate TEE program moderated by:
    a. Ability beliefs?
        i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.
    b. Expectancy beliefs?
        i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.
    c. Utility beliefs?
        i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.
4. What experiences from participation in pre-professional communities of practice do students recognize as influential in their interest in teaching TEE as a future career as well as their intent to continue in their undergraduate program?

5. What are the contextual factors of technology and engineering undergraduate programs that may influence current and potential TEECA members' perception and understanding of the TEE field?

Significance

The findings in this study will be useful to all stakeholders in Technology and Engineering Education, including higher education programs, administration at both the district and state levels, and technology and engineering teachers. These findings will help to show what, if any, influence TEECA participation has on the overall strength of a university TEE program as measured by the retention of students in the undergraduate program and students entering the field of education following graduation. This study may also help to inform future research investigating the impact of communities of practice on students in undergraduate collegiate programs. Finally, this study may help inform stakeholders on how collegiate communities of practice for TEE undergraduate programs impact students' intention to teach. This study will also inform the faculty and administration of Technology and Engineering programs across the nation by further understanding aspects of the structure, enrollment, and practices of other programs.

Summary of the Study Procedure

This study used an online survey to evaluate the involvement of TEE undergraduate students in the pre-professional organization TEECA. The undergraduate students were also asked to rate their beliefs in the three task-values: ability beliefs, utility beliefs, and expectancy beliefs. Along with the task value items, the undergraduate students rated their intent to graduate from their undergraduate program as well as their level of interest in teaching following graduation. The study sought to identify whether a relationship may exist between TEECA participation and undergraduate students' future interests and intentions. Additionally, the study sought to identify if the task-values have a moderating impact on the relationship between TEECA participation and TEE undergraduate students' future intentions. The survey was administered in April and October of 2023 to maximize the number of responses. Following the survey, students were asked if they were willing to participate in a follow-up interview. Participants who indicated a willingness to be interviewed were contacted for further investigation into what experiences from participation in TEECA and their undergraduate TEE program they recognize as influential in their interest in teaching as a future career and their intent to continue in their undergraduate program.

In addition to student responses, program faculty were contacted to provide information regarding the structure and enrollment of their undergraduate TEE programs. This dataset was collected with published data to help provide the contextual factors of

technology and engineering programs that may influence current and potential TEECA members' perceptions and understanding of the TEE profession.

Definitions of Acronyms and Terms

CTE: Career and Technical Education. This field of education focuses on career-focused skills and includes the educational areas of business education, family and consumer science education, agricultural education, and technology and engineering education among others.

ITEEA: International Technology and Education Educators Association. ITEEA is a professional organization for technology, design, and engineering educators. They seek to nurture professionalism and growth within the educational community by providing professional development, membership services, curricular resources, and leadership opportunities (ITEEA, 2024a). The national conference is held in March or April of each year.

Pre-professional Organization: An organization intended for undergraduate students prior to entering their career field to foster networking and technical skills.

Pre-service teacher: An undergraduate student currently enrolled in a teacher preparation program that will have the option to earn a teaching license with their undergraduate degree and pursue education as a career post-graduation.

TEE: Technology and Engineering Education. Educators of TEE receive a secondary education (grades 6-12) license to teach a wide range of subjects, including integrative STEM, woodshop, electronics, and 3D modeling.

TEECA: Technology and Engineering Education Collegiate Association. This is the pre-professional organization under ITEEA intended to provide leadership and professional development to pre-service TEE teachers (ITEEA, 2024b).

TEE undergraduate programs: University programs that teach technology and engineering content with the opportunity to earn a teaching license in the home state of the university.

Assumptions

The assumptions of the study were:

1. Participants were attentive, reflective, and honest with all survey answers.
2. The sample is representative of the TEE undergraduate population.

Limitations

The limitations of the study were:

1. The dissemination of the survey was dependent on TEE program faculty members sending the survey to all current students in their respective programs and was not limited to students pursuing teacher licensure.
2. Students' decision to participate in the survey and/or their responses may be influenced by the semester in which they received the survey email, and their workload (e.g., coursework, employment, etc.).
3. Interviews were coded by one person so interrater reliability could not be found.

Delimitations

The delimitations of the study were:

1. The research will only be conducted with undergraduate TEE undergraduate programs that offer a secondary teaching license upon graduation.
2. The programs selected were affiliated with TEECA in at least one of the past ten years.
3. The study did not investigate pre-professional organization participation outside of TEECA.

4. The study did not include TEECA members enrolled in non-TEE undergraduate programs (i.e., mechanical engineering or elementary education).

CHAPTER II

REVIEW OF THE LITERATURE

Problem Statement

There is an increasing awareness surrounding the nationwide teacher shortage. This shortage is particularly apparent in the field of Technology and Engineering Education (TEE), which has been partly caused by struggling TEE undergraduate programs. Previous studies have suggested that the struggles experienced by these programs have included inconsistencies and confusion between content that teachers are prepared to teach. There is additional confusion between what is expected compared to the experiences of students recruited into the programs (Volk, 2019). While program faculty and leaders within TEE have adjusted to remain relevant within the field of education and industry preparation, limited research has been done surrounding the recruitment and retention in undergraduate TEE programs.

Previous research surrounding teacher recruitment and interest in teaching more generally has been conducted using the expectancy-value theory. Using the Expectancy-Value Theory as a theoretical base, Richardson and Watt (2007) developed the FIT-choice scale to determine why educators choose to pursue education as a career. Previous studies have identified a set of beliefs, as outlined in the FIT-choice scale, that have led to

higher persistence in the field of education. In addition to the study of the impact of these beliefs in the persistence of educators in the educational community, communities of practice have been studied by Lave and Wenger (1991) to observe how participation in a learning community can lead to increased persistence. Previous research has shown that participation in pre-professional organizations, as a community of practice, can lead to an increased desire to enter a field. However, this research on interest in teaching has not extended to students participating in TEE undergraduate programs that offer teacher licensure. Using the lens of the FIT-choice scale belief items, this study investigated the influence of pre-professional communities of practice on the career intentions and the persistence of undergraduate TEE students.

Teacher Shortage

The education system in the United States has experienced recurrent teacher shortages throughout its history (Hawley, 1986; Sutcher, et al., 2019). One of the more recent studies investigating the retention of new teachers revealed that as of 2009, the national average for attrition of new teachers was 33% within the first three years (Brown & Wynn, 2009). Additional findings have shown that about 40-50% of teachers leave the profession within the first five years in the profession (Greiner & Smith, 2009; Tamberg, 2007; Ingersoll, 2003; Lambert, 2006). However, the National Center for Education Statistics (NCES) reported that of the new teachers who started in the year 2007, 17.3%

left within their first five years of teaching. These statistics decreased if the employee entered education with a regular teaching certificate through a teacher preparation program (Gray & Taie, 2015). An additional study released by the NCES showed that teachers who fall in an "other" field of teaching (listed subjects were elementary, special education, arts/music, English/language arts, mathematics, natural sciences, and social sciences) had a higher rate of attrition (Goldring, et al., 2014). Reasons for teachers leaving include retirement, family or personal reasons, pursuing a new career, lack of competitive salaries, fear of personal safety, and job dissatisfaction (Bryner, 2021; Deever, et al., 2020; Ingersoll, 2001). This shortage has also been caused, in part, due to a lack of college graduates from teacher preparation programs (Ingersoll, 2001, 2002; Boyd et al., 2006).

There are many notable costs, including economic and other costs, that come with teacher turnover and attrition (Sorensen & Ladd, 2020). Teacher turnover has been shown to put a substantial strain on financial resources on local areas and school districts in addition to the resources required to train and mentor new teachers (All4Ed, 2014; Barnes, et al., 2007). An additional cost is the negative impact on student experience and performance. With teacher shortages, schools are more likely to hire less experienced teachers, increase class sizes, or cut class offerings (Sutcher, et al., 2019). These changes do not only affect the students who are assigned to inexperienced teachers but also impact all students as it can impede instructional development and collaboration of teachers

(Guin, 2004). These impacts have been found to be prevalent in Career and Technical Education (CTE) (Conneely & Hyslop, 2009). While interest in CTE courses has continued to grow (Ansel, et al., 2022), the number of CTE teacher preparation programs has continued to decrease over the past 30 years (Conneely & Hyslop, 2009; Wilkin & Nwoke, 2011).

Current State of Career and Technical Education

Fluctuations in financial support from the government at both the state and local level have coincided with a decline in the number of CTE classes offered (U.S., 2006). Camp and Heath-Camp (2007) argued that the decline in CTE secondary program enrollment has been caused, in part, by the implementation of high-stakes testing, No Child Left Behind, and funding patterns in Perkins II. They surmised that this combination caused a shift in focus to core classes leaving fewer opportunities for students to enroll in elective courses, such as CTE. This decrease in CTE program enrollment caused a decrease in the need for teachers, which has impacted, and may be causing the loss of, CTE teacher preparation programs.

In addition to declining enrollment in secondary CTE programs, enrollment in undergraduate CTE teacher preparation programs has been a growing concern throughout the United States of America (Fletcher, & Gordon, 2017; Moye, 2009; Volk, 1997). Brown (2012) suggested that the decrease in undergraduate students enrolled in pre-

service teacher programs has caused a negative cycle in CTE. The decrease in graduates from CTE teacher preparation programs has led to an increase in difficulty in replacing teachers leaving the field, which can result in the discontinuance of CTE programs in schools. The lack of teachers, along with the closure of programs, has caused the nation to face a reduction in CTE classes offered (Moye, 2009).

Despite these issues, statements from government officials have shown support for CTE (Obama, 2013). Concern over unfilled technical positions within industry and student interest has led to a call for increased access to CTE courses (Palaniappan, 2020; USDOE, 2000). However, without CTE teacher preparation programs, such as Technology and Engineering Education (TEE), student access will continue to be limited.

Defining TEE and Why We Need It

Many of the practices and concepts taught years ago are insufficient to prepare students with the knowledge and skills necessary for the technological changes that have given rise to modern industry (Vosniadou, 2007). The Industrial Revolution has already experienced three waves as it has progressed. Developed nations are experiencing its fourth wave, known as Industry 4.0, with digitalization and improved manufacturing practices (Spöttl & Windelband, 2021). As new theories and technologies are developed, it is imperative to prepare students in the rising generation for industry with updated

knowledge, skills, and practices (Autor, et al., 2003). International efforts have been implemented within education with a focus on improving STEM education to prepare students for Industry 4.0 (Akgunduz & Mesutoglu, 2021; Erickson, 2022; Rahayu, et al., 2020; Rais, 2018). With these efforts, there remains a continued need to keep educational practices up to date in the world of technical education.

In 1996, Lynch argued that if CTE did not evolve in its content, the programs would abate and become irrelevant. Much of CTE's relevancy has come from the focus on college and career preparation (Carnevale, et al., 2010; Loera, et al., 2013). The field of CTE is often recognized as a strong contributor to today's workforce development within secondary education (Jacobs & Hawley, 2009). Skills offered in CTE courses include sewing, business, computer science, welding, food preparation, problem-solving, and manufacturing. As college majors and career options have shifted, so has the field of CTE (Brewer, 2011). Under the CTE umbrella, leaders in the field of technology education (encompassing industrial arts, robotics, computer science, and engineering) have joined in the effort to update curriculum and practices to continue in their goal of preparing students for industry and higher education (Moye, et al., 2015).

The scope of subjects taught within technology and engineering education have become a point of confusion among all the CTE subjects (Wicklein, 2006). This confusion has stemmed, in part, from members of the TEE community struggling to agree on the content and focus of TEE curricula (de la Paz, 2017). The puzzle of TEE's

identity has been complicated by leaders of the TEE community adjusting its name and content regularly since its creation (Reed, & LaPorte, 2015). In the past 40 years, the major professional organization for technology and engineering educators has changed its name twice starting with the shift from American Industrial Arts Association (AIAA) to the International Technology Education Association (ITEA) in 1985 to realign with the changing workforce and educational needs of the time (Litowitz, 2008). The 1985 name change was inspired by the shift in the American economy from industrialization towards a more technological society (Litowitz, 2008). ITEA went on to release the Standards for Technological Literacy (STLs) to give this adjustment more focus and coordination. Leaders and members of ITEA hoped the development of the STLs would help direct an update to curricular content and increase the focus on keeping up with the changing technological world (ITEEA, 2000, 2002, 2007). The release of the STLs offered a stronger foundation of support as schools across the nation made the update to teaching current technologies (Hook, 2001).

The second shift happened in 2008, when the ITEA board recognized the emphasis on engineering that was happening in the field of technology as well as technology education. Engineering quickly became a common topic of interest with increasing popularity at the annual ITEA conferences (Reed & LaPorte, 2015). While the movement to include engineering within the field of technology education was faced with general agreement, much disagreement remained surrounding where engineering would

fit in the profession of education. Most of the technology education community chose to adopt engineering concepts and courses into its curriculum, but some felt that without a name change for the profession, there would be confusion about the scope of technology education (Starkweather, 2008). This led to the profession becoming what is now commonly referred to as Technology and Engineering Education (TEE) (Strimel, et al., 2016). As it encompassed engineering within its content, the national organization chose to update its name to the International Technology and Engineering Education Association (ITEEA) in 2010 (Reed & LaPorte, 2015). With the integration of engineering within the TEE curriculum, renewed promise was shown in TEE's ability to provide additional opportunities to increase technological literacy and introduce students to more career opportunities (NRC, 2009).

In each iteration of change of name in the TEE profession, the goal was to remain current and continue to prepare students for college and careers (Saeger, 2017). This remains more imperative now than ever before as the current industry requires a higher level as well as a wider variety of skills than has been required previously (Hodes & Kelly, 2017). CTE educators are now expected to provide opportunities for workforce development along with technological literacy within their curriculum to receive the funding needed to continue to maintain and grow their program. The foundational skills and knowledge that can be provided by TEE courses could be instrumental in providing these opportunities. To continue to provide these skills and knowledge to students, it is

important that TEE teacher preparation undergraduate programs not only recruit and retain students but also successfully transition them into the field of education.

TEE Teacher Preparation Undergraduate Programs

In striving to understand the status of undergraduate TEE teacher preparation programs, Love and Maiseroulle (2021) found that confusion and inconsistency were prevalent among undergraduate TEE programs. TEE undergraduate programs across the nation have altered their programs to offer TEE teacher licensure through certificates as well as graduate degrees. They also found that several programs also offer not only a secondary certification, but certifications to teach TEE content for grades P-12, and as an available option or additional endorsement. In their research of various programs, they also identified programs that have been discontinued between the years 2015-2019.

In a further inspection of the status of technology and engineering education, Moye, et al. (2020) found that current trends contributing to the teacher shortage have to do with compensation, low funds to support programs, and varying curriculum. Some who may have considered studying in a TEE undergraduate program were aware that the content learned in technology and engineering undergraduate programs build skills and knowledge for an industry position where compensation is significantly higher. To address these issues, further knowledge and understanding are needed to help recruit and

retain students who have the right qualities and/or desires to be educators within the technology and engineering field of education.

Despite efforts to ensure the future of TEE within education, there remains instability in the strength of TEE undergraduate programs (Love & Love, 2022). The past 45 years have shown a decrease in TEE teacher programs across the nation (Love, 2016; Moye, 2009). In 2015, ITEEA reported 43 existing TEE teacher preparation programs, showing a large decrease in the span of eight years from a reported 72 programs in 2007 (Warner, et al., 2007). Recent studies investigating the preparation of current technology and engineering educators and their undergraduate programs have addressed the curriculum and content offered to these students (Litowitz, 2014; Strimel, 2013). The courses offered to students include a wide variety of science, energy and power, and design classes that allow students to go into both teaching and other STEM fields. In expanding these investigations of teacher preparation, Love, et al. (2016) further investigated informal and formal preparation experiences. These experiences included participation in clubs and individualized mentoring received from faculty. It was concluded that technology and engineering educators are the most influential figures for recruiting future educators.

Additional studies emphasized the influence of individuals in TEE program recruitment. Love and Love (2022) used a binomial variable survey looking for students' perceptions of influential or not influential variables in students' recruitment into

Technology and Engineering Education programs. In this study, this variable was considered highly influential if 50% or more of students valued that variable as influential. Using this data, they found that face-to-face interactions with secondary level Technology and Engineering educators, alumni, and faculty members, as well as an interest in hands-on hobbies related to the field, were significant influencers in pursuing a Technology and Engineering Education degree. Brochures, school counselors, and social media were not found to be influential.

Retention in Teacher Preparation Programs

Retention of undergraduate students is a topic of interest for many programs. Previous studies have focused on first-generation students, minorities, transfer students, students recovering from academic probation, and first-year students (Brooks, et al., 2013; Caporale-Berkowitz, et al., 2022; Chamely-Wiik, et al., 2021; Lei & Yin, 2020; Zegre, et al., 2022). In a review of literature, Lei and Yin (2020) noted that department-sponsored events and activities, including clubs, organizations, and field trips influence satisfaction and retention of undergraduate students. It was found that the increased interactions with peers through active involvement in these activities were beneficial for academically struggling students. Additionally, the organized events and activities provided positive college experiences in general. These findings were supported by findings from Eather, et al. (2022) that emphasized the benefit of peer mentoring and other peer-assisted learning experiences.

Pre-Professional Organizations

Within the field of agricultural education, an adapted FIT-Choice Scale model, Ag Ed FITChoice® Model (Lawver 2009; Lawver & Torres, 2012), was utilized by Ingram, et al., (2018) to investigate the influence of participation in pre-professional organizations at the secondary level influenced agricultural education majors' intentions to teach. One theme that emerged from the data included "Socializer Influencers," which were key individuals who influenced undergraduate agricultural education students' career decisions. The participants noted that the hands-on and club experiences received from participating in agricultural education provided a greater opportunity to impact future students. However, using the Ag Ed FITChoice® Model, it was noted that the number of years of participation in the agricultural education pre-professional organizations was not a significant predictor of a student's intention to teach (Lawver & Torres, 2011).

Experience outside of school, such as work and volunteering, within a career field helps college students develop pre-professional identity (Clanchy, et al., 2021). This development of pre-professional identity allows for undergraduate students to develop persistence in their undergraduate program into their future profession (Burleson, et al., 2021; Spector, 2022). Similarly, once in the field, professional identity has been found to help educators persist in their profession (Cunningham, 2020).

Though existing research on the shortage of TEE graduates focused on TEE teacher preparation programs and the variations between them, no studies exist surrounding collegiate experiences that encourage retention of undergraduate TEE students and increase their intention to pursue teaching as a profession. Future studies surrounding student experiences in undergraduate TEE programs may inform current programs in practices to help with recruitment, leading to an increase in the number of TEE teachers in the field of education.

TEECA Participation

While many differences exist between TEE undergraduate programs, one opportunity available to all TEE undergraduate programs across the nation is affiliation with the Technology and Engineering Education Collegiate Association (TEECA). TEECA is the student pre-professional organization affiliated with the International Technology and Engineering Educators Association (ITEEA). Undergraduate TEE programs have the option to sponsor a TEECA chapter, and students can register as student members in ITEEA, which will automatically give the student TEECA membership. By attending ITEEA and TEECA events, undergraduate students are afforded opportunities to network with other undergraduate students as well as current educators, administrators, and other TEE professionals across the nation. This, in turn, opens job opportunities and increases skill and understanding in the field. Despite its

availability, not all TEE undergraduate programs have an affiliated TEECA chapter. Additionally, of the affiliated chapters, degrees of involvement in regional and national TEECA functions vary between each chapter. Additionally, the level of individual student engagement varies between and within TEECA chapters.

One opportunity offered to TEECA students is the ability to participate in national competitions at regional and national conferences. These competitive events include communications, manufacturing, problem solving, robotics, and teaching lessons. These events are intended to help students strengthen their technical and pedagogical skills as well as increase involvement in the field (ITEEA, 2023a). TEECA chapters may also engage in service activities, community outreach, fundraising, and professional development.

Theoretical Framework

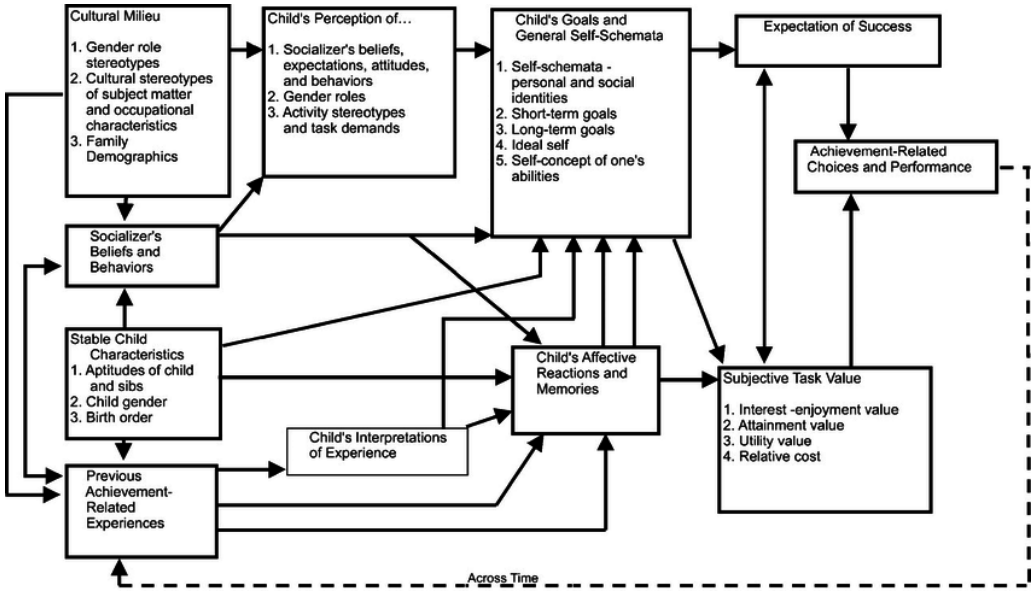
Expectancy-Value Theory

The Expectancy-Value Model of Achievement Performance and Choice looks at how individuals assign values to tasks based on how they expect they will perform. These expectancies and values help to explain how the assigned values influence effort, performance, and persistence in a task (Wigfield, 1994). One important distinction in the expectancy-value model is that it focuses on expectations of success as opposed to

outcome expectations - it does not predict performance. Early studies found that ability-related beliefs in elementary-aged children showed a relation to performance, but no relation was found between performance and achievement values (Figure 1; Wigfield, et al.,1998). Following the early studies observing expected performance and assigned value in children, the Expectancy-Value Theory has frequently been utilized to explain why individuals pursue careers or education.

Figure 1

Expectancy-Value Theory



Note. The Expectancy-value model. From "Expectancy-Value Theory of Achievement Motivation," by A. Wigfield and J. S. Eccles. (2000). *Contemporary Educational Psychology, 25*, 68-81. Copyright 2000 by Wigfield and Eccles.

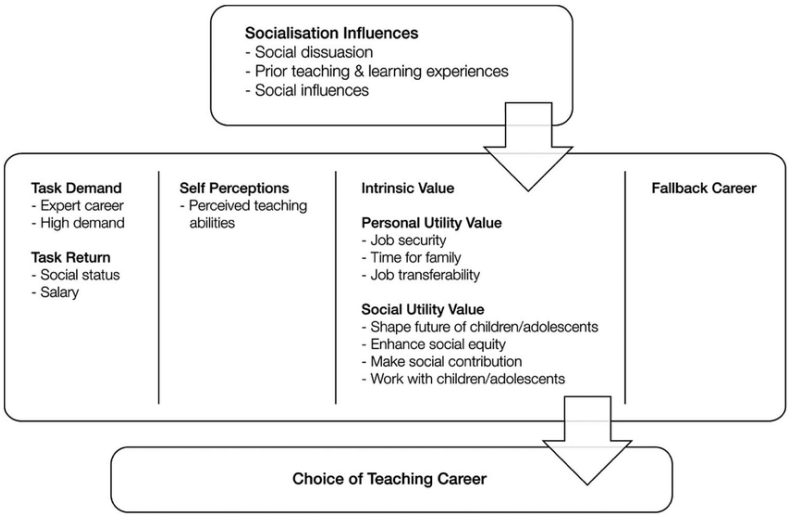
One of the first studies using the expectancy-value model within education was implemented to measure achievement performance and choice within the context of math classes (Wigfield & Eccles, 2000). When measuring ability beliefs, it became important to measure expectancy beliefs that are domain specific and not activity-specific (i.e., measuring calculus [domain], but not measuring a student's self-expectancy to perform a derivative [activity]). Educational domains that have been explored with this model include math, sports, science, and language (Wigfield & Eccles, 2000; Guo, et al., 2017; Loh, 2019; Lauermann, et al., 2017).

Teacher Recruitment within the Expectancy-Value Theory

Within the expectancy-value framework, Watt and Richardson (2007) worked to explain the motivators behind Factors Influencing Teaching Choice (FIT-Choice). This study originally took place in Australia looking at the motivators for individuals to work within the teaching profession. By simplifying the expectancy-value theory to look specifically at experiences and motivations that teachers experience, the FIT-Choice model was created (Figure 2).

Figure 2

FIT-Choice Scale Model



Note. The FIT-Choice theoretical model. From "An introduction to teaching motivations in different countries: Comparisons using the FIT-Choice scale", by Watt, H., and Richardson, P. (2012). *Asia-Pacific Journal of Teacher Education, 40*(3), p. 187. Copyright 2008 by Helen Watt & Paul Richardson. Copyright 2012 by Watt, et al.

For the FIT-Choice model, teachers were asked to respond on a scale from 1-7 on how important each of the factors were in choosing to become a teacher. The factors included each of the listed items within the model from social dissuasion to work with children/adolescents. In Australia, the highest-ranking motivators were perceived teaching ability, the intrinsic value assigned to the career by the individual, the

opportunity to shape the future of children/adolescents, and the individuals' prior experiences in teaching and learning (Richardson, et al., 2014). Recognizing that there may be differences between countries in teacher expectations and outcomes, Watt, et al. (2012) conducted an additional study that was initiated to include Germany, the United States, and Norway. It was revealed that motivations did vary from country to country. However, the high motivators found in Australia were found to be the same for teacher expectations and outcomes, Watt, et al. (2012) conducted an additional study that was initiated to include Germany, the United States, and Norway. It was revealed that motivations did in fact vary from country to country. However, the high motivators found in Australia were found to be the same in the United States.

From the FIT-Choice studies, three clusters of pre-service teachers were identified. Within the United States, these clusters were "highly engaged persisters," "lower engaged desisters," and "classroom engaged careerists." The lower engaged desisters were found to show low motivational scores and often identified teaching as a fall-back career. However, both highly engaged persisters and classroom engaged careerists revealed that their motivations were centered around social utility and socialization influences, such as prior teaching and learning experiences and a desire to enhance social equity (Richardson, et al., 2014).

With the expectancy-value theory as a framework, additional studies added to this body of knowledge by studying practicing teachers by choosing to evaluate pre-service

teachers (Manuel & Hughes, 2006). Manuel and Hughes (2006) determined that pre-service teachers' motivations to enter the field of education included personal fulfillment, working with children/adolescents, the expected lifestyle, working conditions, and enjoyment of the subject to be taught.

While these studies help to identify why individuals may enter the field of teaching, it does not help to explain if these same motivators are what retains them and helps them to persist during their pre-service teaching experience. Further research is required to understand and improve retention and motivation for undergraduate students entering the field of education.

Pre-service Teacher Undergraduate Preparation and Retention

In the preparation of pre-service teachers, it has been reported that field experiences are the most influential aspect of their teacher career preparation (Erdem & Demirel, 2007; Guyton & McIntyre, 1990; Hollins & Guzman, 2005). Field experiences here are defined as learning by doing (Cruickshank & Armaline, 1986). In the creation of personal identity, pre-service teachers often connect with the positive field experiences they have when in the field (Dassa & Derose, 2017). Teachers who reported feeling positive during field experiences felt they would succeed in creating positive teaching environments for their future students (Beltman, 2015). Rogoff (1991) explained that to become a skilled practitioner within one's community, the learner should participate in

various and repeated experiences. This experience should include both routine experiences and challenging situations. For some skills, pre-professional organizations have helped to provide the experience and skills needed to feel confident in pursuing school positions post-graduation (Cobb, et al., 2015).

Communities of Practice

One venue that may help to provide these experiences and increase persistence in the career field is through participation in a community of practice, such as a pre-professional organization. Communities of practice is a concept popularized by Lave and Wenger (2004), which explains that learning happens the best when situated in context and with peers and mentors. Communities of practice involve individuals with a shared subject of interest engaging in shared activities. This allows for participants to utilize the shared experiences and tools within the domain to strengthen learning and experience. Communities of practice provide a strong socialization influence that may impact the value beliefs as identified in the FIT-Choice model.

Wenger (1998) explained that in addition to the shared engagement, the community of practice must be a joint enterprise that is understood by all participants and is regularly negotiated. This engagement and negotiation allow the community to develop communal resources that are accessible to all members. Effective communities of practice move the members through five stages of development with the common

objective of mutual long-term support and persistence. These stages are Potential, Coalescing, Active, Dispersed, and Memorable. The Potential stage involves participants facing similar situations without previous shared experiences or practices. The Coalescing stage is when members of the community begin negotiating their experiences together. The Active stage is when participants begin to develop the shared repertoire and resources through joint activities. The Dispersed stage involves members no longer actively engaging in their community, but the community still exists as a center of knowledge that can be referred to. The Memorable stage involves participants being able to refer to their experiences within their community and acknowledge it as central to their identity.

Additionally, Wenger (1998) also clarifies that a Community of Practice is not the same as a functional unit, team, or network. A defining characteristic of Communities of Practice is the social experience of learning by doing together. The community is more than a network of connections, does not begin and end with a specific project, and should engage all members as decision-makers or contributors. While not all organizations would be considered a Community of Practice, Communities of Practice can exist within an organization both officially and unofficially.

These communities can be flexible and exist in different forms with varying benefits. On the collegiate level, students have reported that they persisted in activities because participation helped them to feel more fully part of a larger community (Hall,

2006). Additionally, participation in the national events of shared communities has been found to increase the participant's perceived ability (Gehrke & Kezar, 2019). This perceived ability can work to increase one's value of, and intention to remain in, the field associated with the community of practice.

Summary

We are facing a national teacher shortage. This is a prominent issue in Career and Technical Education including Technology and Engineering Education. While stakeholders in TEE have worked to stay up-to-date and relevant in the changing world of technology, TEE undergraduate programs have increasingly failed to meet the demand for new teachers due to low enrollment and subsequent program closures. The expectancy-value theory provides an avenue to investigate the impact of pre-professional organizations, as communities of practice, on undergraduate students' choice to complete their TEE undergraduate program and pursue a teaching career. The purpose of this study is to investigate the relationship between pre-service teachers' participation in pre-professional organizations and their intentions to complete the TEE undergraduate program and their interest in pursuing a career as a TEE educator using both quantitative and qualitative data. Additionally, this study will investigate how these relationships are moderated by ability, expectancy, and utility beliefs. Lastly, this study will examine the

contextual factors that may influence undergraduate TEE student's perception and understanding of the TEE field.

CHAPTER III

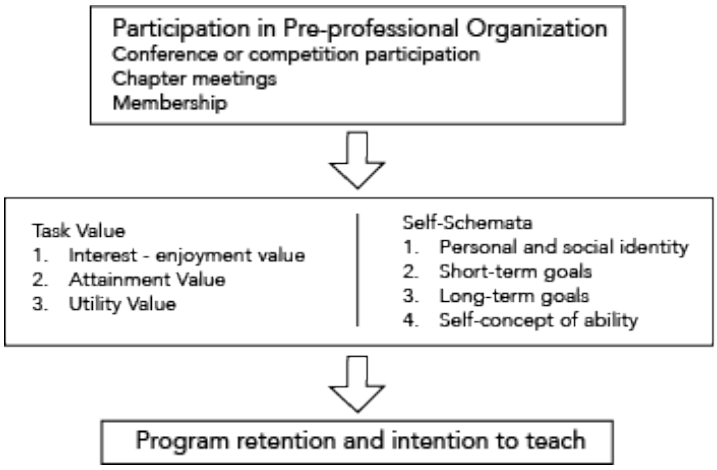
METHODOLOGY

Communities of Practice within the Expectancy-Value Theory

To measure the influence that participation in a pre-professional organization has on an undergraduate student's persistence and intention to teach, this study used expectancy-value theory as the overall framework, while incorporating communities of practice (Figure 3). The pre-professional organization, as a community of practice, was believed to provide the socialization, prior learning, and teaching experiences that increase the perceived task values of students, as it relates to their professional and educational goals. These task values were broken up into the participant's ability beliefs, expectancy beliefs, and utility beliefs. The ability belief is the participant's belief in their ability to perform the task, the expectancy belief is the expectancy of personal success at the task, and the utility belief is the value of the task in contributing to society. These task values were hypothesized to serve as moderating variables in the relationship between TEECA participation and undergraduate student's intention to retain in the major and teach.

Figure 3

Model of undergraduate student retention through participation in pre-professional organizations



Research Design, Population, and Sampling

This study utilized a cross-sectional design to investigate the impact of TEE students' participation in the Technology and Engineering Education Collegiate Association (TEECA), the TEE pre-professional organization, on their persistence in a teacher education program and level of interest in pursuing a teaching career following graduation. The sample consisted of current students in TEECA-affiliated undergraduate programs in the United States of America. The voluntary-response sampling procedure relied on TEE program faculty disseminating an online survey to the students enrolled in their programs. At the end of the survey, students were redirected to a separate survey

inviting them to participate in an optional semi-structured interview. Students could choose if they wanted to elect to provide their contact information that could lead to a follow-up interview. This study sought a census of students across the nation enrolled in undergraduate TEE programs.

Instrument Development

While looking at persistence for undergraduate students enrolled in undergraduate programs offering licensure in Technology and Engineering Education through participation in a Community of Practice with the framework of the Expectancy-Value theory, the factors influencing "highly engaged persisters" and "lower engaged desisters" belief values from the FIT-Choice Scale were identified and used. These factors were ability beliefs, utility beliefs, and expectancy beliefs. Socialization influences were used as an input through participation in communities of practice.

Instrument Validity

To ensure the face validity of the instrument, several checks were performed. First, the survey was reviewed by agricultural education and technology and engineering education content and academic specialists to check for correct wording in the modification of some of the belief statements to ensure these beliefs were accurately measured in the context of TEE students. These specialists also have expertise in

instrument and survey development. In addition to the specialists reviewing the survey, the survey was sent to agriculture education students to check for clarity of instructions and concepts. Agriculture education was identified as a comparable field of study as it falls under the CTE umbrella, has a foundation in vocational skills and lab-based education, and has a pre-professional organization that college students can participate in. In the survey sent out to agriculture students, there was a slight wording adjustment looking at participation in the National FFA Organization and their intentions to pursue Agriculture Education instead of TEECA and their intentions to pursue Technology and Engineering Education. Additionally, at the end of the survey, they were asked if any part of the survey was confusing or needed clarification. The feedback and recommendations of each reviewer and student were reviewed for incorporation into the final survey instrument (Creswell & Poth, 2018). The survey for both the agricultural education students as well as the final instrument used to answer research questions within this study can be found in Appendices A and B.

Quantitative Research Questions

The first questions posed in this investigation were:

1. What relationship, if any, exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and their:

    a. Interest in teaching TEE as a future career?
    b. Intention to complete their undergraduate TEE program?
2. Is the effect of participation in TEECA on an undergraduate TEE student's interest in pursuing teaching as a future career moderated by:
    a. Ability beliefs?
    b. Expectancy beliefs?
    c. Utility beliefs?
3. Is the effect of participation in TEECA on an undergraduate TEE student's interest in completing their undergraduate TEE program moderated by:
    a. Ability beliefs?
    b. Expectancy beliefs?
    c. Utility beliefs?

To answer these research questions quantitative data were collected through a survey. The methods of collection are explained in the next section.

Quantitative Data Collection

To collect quantitative data to answer research questions one through three, an online survey was distributed to current faculty of TEE undergraduate programs on the TEECA listserv with instructions to forward the survey to students then enrolled in their programs. Prior to the survey dissemination, an announcement was given at the national

TEECA closing ceremony during the International Technology and Engineering Educators Association (ITEEA) conference in April 2023 that a survey would be going out to faculty members. The students and faculty were informed that the faculty members would be asked to disseminate the survey to all students in their program. According to the ITEEA website, there were eight universities with current TEECA affiliation as of April 2023 (ITEEA, 2023b). In addition to these universities, other TEE programs that had been affiliated with TEECA in the past ten years were contacted. As the conference was held in mid-April, students in TEE programs had anywhere from two to six weeks remaining in the term before summer break, depending on the university.

After the first wave of survey distribution, the study was faced with a low response rate, with 67 surveys started and 44 surveys filled out to completion. TEE program leaders were asked to send the survey out once again at the end of September 2023. This resulted in an additional 30 surveys started and 16 surveys filled out to completion, for a total of 60 completed surveys that could be used in their entirety for this study. One survey was filled out with all but one question regarding interest in the content area, so some fields measuring belief items had 61 populated responses ($N = 61$).

Variables

The quantitative data in this study investigated one independent variable, two dependent variables, and three moderating variables. All survey items used for these variables can be found in Appendix B.

Independent Variable. The independent variable for this study was the level of pre-professional organization participation. There were four items of participation incorporated into this variable. These items included being a registered member of the organization, attending chapter meetings, attending regional or national conferences, and participating in events. The survey sought to measure the number of years the student had been a registered member of TEECA, how regularly they attended chapter meetings, how many regional and/or national conferences they had attended, and how many TEECA events or challenges they had participated in (Appendix B). For each item (i.e., registered member of TEECA, attend chapter meetings, attend conferences, attend chapter events) a student was assigned a yes (1) or a no (0) for participation. Students were then left with an ordinal participation level with 0 being no participation, 1 being little participation, 2 being moderate participation, 3 being high participation, and 4 being full participation. Students who were registered members who attended chapter meetings but had never

attended a regional or national conference or participated in competitive events would be placed at a level 2 participation.

Dependent Variables. The dependent variables were the study participant's interest in pursuing a career as an educator in technology and engineering following graduation as well as the participants' intention to persist in the TEE undergraduate program. Each of these dependent variables related to students' interest in teaching and intent to persist in their undergraduate program were measured on a 5-point Likert scale (Appendix B). Both variables reflected the structure and phrasing of the original FIT-Choice Scale (Watt & Richardson, 2007).

Interest in Teaching. Participants were asked to rate the interest statement, "I am interested in teaching" on a five-point Likert scale on a scale from "Not true at all" to "Very true." These values were coded to a scale from zero (not true at all) to four (very true).

Intent to Persist. The second interest variable measured students' intent to complete their undergraduate program. Participants were asked to rank the statement, "I plan on graduating from my major," on a five-point Likert scale from "Not true at all" to "Very true."

Moderating Variables. Moderating variables for the study included the three belief factors. All statements used to measure the belief factors that were based on the

original expectancy-value model study from Wigfield and Eccles (2000) as reflected in the FIT-Choice Scale (Watt & Richardson, 2007). For each of these factors, participants were given a set of statements (i.e., How good at teaching are you?) and a scale from 1 (not good at all) to 5 (very good). Participants were expected to rank the strength of agreement or belief on each of those items. All belief and persistence items as well as the adjoining scale statements for both the moderating and the dependent variables can be found in Appendix B. The belief factors measured were:

1. Ability Beliefs: Measure perceived competency in their content area.
2. Expectancy Beliefs: Measure students' expectations to succeed in their content area.
3. Utility Beliefs: Measure the perceived usefulness and importance that the participants had of teaching as a profession.

Quantitative Data Analysis

Demographic data were translated into numeric numbers (i.e., four was translated to 4) or coded using a code book (i.e., male was coded as zero, female was coded as 1, and non-binary/third gender was coded to 3, etc.). The belief factors answered by participants on a 5-point Likert scale were coded to a scale from one to five. Once the data were in numerical form, the following analyses were used to assist in the investigation of this research project.

Spearman's rho Rank Correlations

In looking at an undergraduate TEE students' interest in teaching as well as intentions to graduate from their current undergraduate program, students were offered the following statements to be self-evaluated on a 5-point Likert scale.

1. I am interested in teaching (Not true at all Very true)
2. I plan on graduating from this major (Not true at all Very true)

These statements were used to answer research question number two using a correlation model. As the data were ordinal and were not normally distributed, as observed by histograms (Figures 4-6), Spearman's rho correlation was used for this analysis.

Figure 4

Histogram for Participation Level

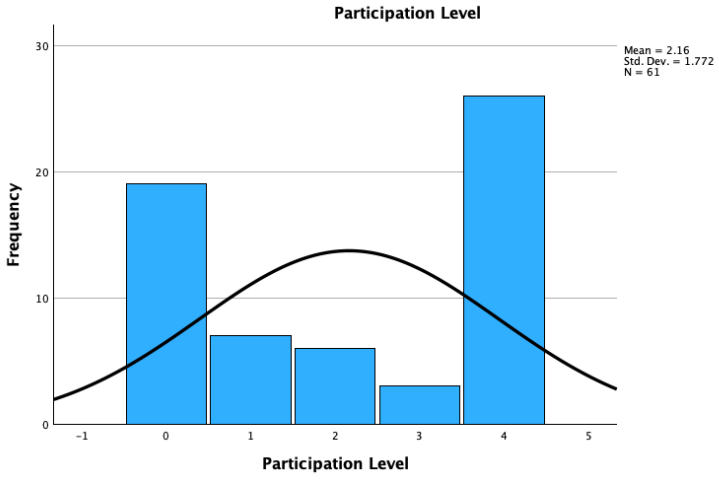


Figure 5

Histogram for Interest in Teaching

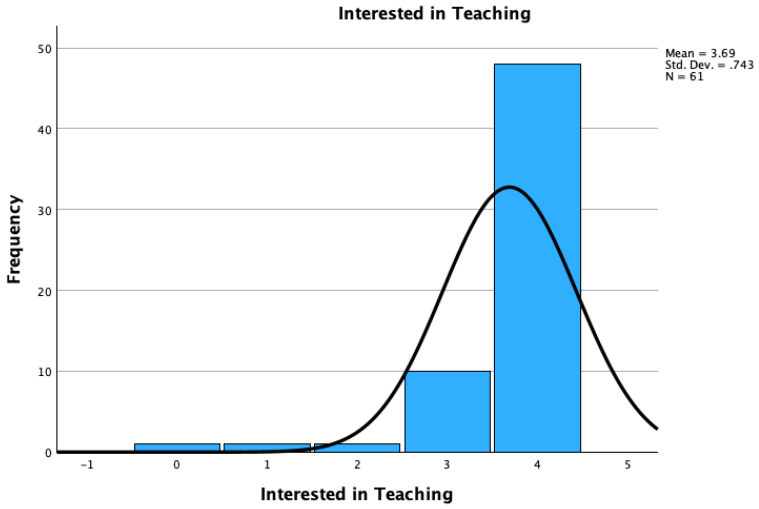
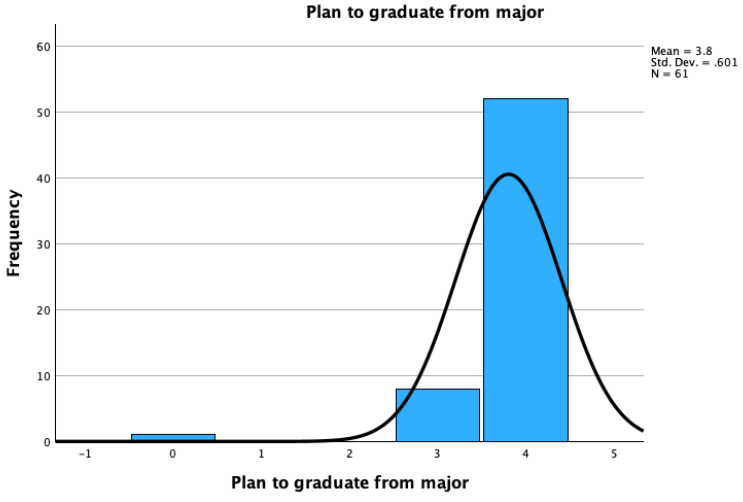


Figure 6

Histogram for Intentions to Graduate from Major



To continue with the Spearman's rho correlation, the following assumptions were evaluated.

1. Both variables in the correlation were measured on an ordinal, interval, or ratio scale.
2. The two variables represent paired observations.
3. The two variables have a monotonic relationship.

Exploratory Factor Analysis

The statements used in this study were modified statements from the FIT-Choice Scale. The original instrument was designed to measure factors influencing in-service teacher's decision to teach. However, this study was investigating potential pre-service teachers and not in-service teachers, and the subject of technology and engineering education has not been isolated in a previous study using the FIT-Choice Scale. As a result of these modifications, an exploratory factor analysis was performed to evaluate the items measured were correctly grouped. The factors along with their reliability were found.

Moderation Analysis

From the factors identified in the exploratory factor analysis, a summated mean score was calculated for each factor. The summated mean score was used in a moderation

analysis to determine the moderating effects on the relationships between participation in TEECA and an undergraduate TEE student's future career as well as their program intentions. To perform the moderation analysis, the independent variable of participation in TEECA as well as the summated mean scores of the moderating variables found in the factor analysis were standardized to meet the following assumptions.

1. The dependent and independent variables are measured on a continuous scale.
2. The moderator variable is a nominal value with at least two groups.
3. The independent, dependent, and moderator variables have a linear relationship.
4. The data does not show multicollinearity.
5. There are no significant outliers.

Using the standardized scores, interaction effects were calculated by finding the product of the standardized independent variable with the standardized factors. Finally, a moderation analysis was conducted using the interaction effects with TEECA participation, teaching interests, and program intentions to examine if the effect that participation in TEECA has on future intentions is the same across different levels of the moderating variables.

Quantitative Data Analysis Summary

All statistical analyses used for the quantitative research with their variables can be found on Table 1.

Table 1

List of analyses and variables contributing to the analyses

Comparison	Variables	Analysis
Investigated the existence of a relationship between participation in TEECA and an undergraduate student's interest in teaching.	TEECA participation and teaching interest	Spearman's rho Correlation
Investigated the existence of a relationship between participation in TEECA and undergraduate student's intentions to graduate from the TEE undergraduate program.	TEECA participation and graduation intentions	Spearman's rho Correlation
Evaluate if the items pulled from the FIT-choice scale loaded as they were intended for the moderation analysis	Belief items used in survey instrument (found in Appendix B)	Exploratory Factor Analysis
Evaluate the reliability of the constructs found in the factor analysis	Factors found in factor analysis as well as belief items used in survey instrument	Factor Reliability
With the belief factors identified, a new variable incorporating all the identified variables was created	Factors found in factor analysis	Summated mean score

For the moderation analysis, the new factors needed to be standardized for the test	TEECA Participation and summated mean scores of factors found in the factor analysis.	Create standardized variables
The standardized variables were used to create intercepting variables to create the standardized moderating variables	Standardized independent variables, standardized moderating variables	Calculating interaction term
Testing to see if the belief values identified have influence on the relationship on participation in TEECA and a student's interest in teaching and persist in their undergraduate program	Participation, interaction variables, program intentions, and teaching interests	Moderation analysis

Qualitative Research Questions

The qualitative questions posed in this investigation were:

1. What experiences from participation in pre-professional communities of practice do students recognize as influential in their intentions to pursue teaching as well as their intentions to continue in their undergraduate program?
2. What are the contextual factors of technology and engineering undergraduate programs that may influence current and potential TEECA members' perception and understanding of the TEE field?

Influential Student Experiences

To investigate the impact that TEECA may have had on undergraduate students, at the conclusion of the survey, students were asked whether they were willing to participate in a follow-up interview. The use of both quantitative and qualitative methods to answer the research questions led this study to a multiple method approach. This approach allowed for the qualitative data to stand independently from the quantitative findings of this study (Tashakkori, & Teddlie, 2021). The students who expressed a willingness to participate were contacted to schedule an interview at a time of their convenience.

Data Collection

Further interviews were done by a convenience sample. There were 24 individuals who expressed a willingness to participate in this interview. Everyone was contacted via phone or email, depending on the preferred method of contact as provided by the participants. After being contacted, a total of 8 students responded and were interviewed one-on-one through Zoom. The interviews were approximately 15-minutes and were semi-structured. Participants had the option to be interviewed with or without video. The interviews included questions regarding their participation in TEECA, what led them to

their undergraduate program, and how their experiences with TEECA, as well as their undergraduate program, have influenced their intentions to pursue teaching or continue in their undergraduate program (Appendix C). Following the interview, interviews were transcribed. The transcribed data were used for analysis. It should be noted that the researcher has been involved in TEECA as an event author for the past six years, so she may have known or interacted with some participants prior to the study.

Data Analysis

As one purpose of this project was to investigate the influence of communities of practice on students' career and undergraduate persistence intentions, a codebook was developed to identify common student experiences within TEECA, experiences in their degree program, and how these experiences have shaped their future intentions with respect to pursuing a career in teaching and completing their undergraduate program. The codebook outlined codes that were used as a framework to outline topics discussed and themes relating to these topics were identified under each of these codes (Table 2). Interview data were coded using NVivo 12.

Table 2

Codebook used in qualitative analysis

Code	Description of Code

Involvement in TEECA	Self-reporting of the involvement the students had in TEECA. This includes any officer positions held, conferences attended, competitions that they participated in, and how active they are in their school chapter.
Influence of TEECA Involvement	How participating in TEECA has influenced the student's career intentions or intentions to continue in their undergraduate program.
Program Experience	Students reporting their experience in their program, both positive and negative.
Program Selection	Factors that led students to pursue their undergraduate program.
Program Influence	How the experiences in their program have influenced the student's career intentions or intentions to continue in their undergraduate program.

Note. The indented codes (Program Selection) are themes of the last non-indented code (Program Experience).

Contextual Factors of TEE Community

Throughout the process of contacting program faculty for the dissemination of the survey to undergraduate students, confusion emerged from faculty members regarding which students should receive the survey. With program structure and student populations differing from program to program, it became clear that the current state and situation of undergraduate programs varied across the nation. The variations found across programs led to the final research question investigating the contextual factors of TEE

programs, which might impact TEECA students' perceptions and understanding of the profession.

Data Collection

To identify current TEE programs across the nation, a search was conducted utilizing the National Center for Education Statistics (NCES) tool for the Technology Teacher Education/Industrial Arts Classification of Instructional Programs (CIP) code. From this point, a program search was done using the College Navigator Tool. The results from the NCES search were then cross-referenced with Love and Maiseroulle's (2021) findings to identify which universities have been identified as having some form of a Technology Teacher Education program.

Additionally, faculty from the TEECA listserv were also contacted via email to provide contextual information regarding their program. For those that did not respond to the initial or follow-up emails, alternative faculty were contacted for the requested information. The information requested included the official title of the undergraduate major, whether teacher licensure was included for all degree completers or if it was one of multiple pathway options. Faculty also provided student enrollment numbers and the male to female to non-binary demographics of their program. Programs were also asked to share the status of their program's involvement with TEECA (e.g. currently affiliated, affiliated previously, etc.).

Summary

This study utilized a cross-sectional design to investigate the relationship between undergraduate students' participation in a pre-professional organization as a community of practice and their intentions to persist in the TEE undergraduate program they are enrolled as well as their interest in entering the field of education post-graduation within the framework of the expectancy-value theory. This study also looked at ability beliefs, utility beliefs, and expectancy beliefs as moderating variables on the relationship between participation and teaching interest, as well as the relationship between participation and persistence intentions. Additionally, interviews conducted with students assisted to answer the research questions in this investigation regarding students' participation in communities of practice and their future career and undergraduate program intentions. Finally, contextual factors surrounding undergraduate TEE programs that may influence TEECA members' perception and understanding of the TEE field were investigated.

CHAPTER IV

FINDINGS

Introduction

This chapter outlines the findings derived from the qualitative and quantitative analysis of the data collected from the surveys taken by the participating undergraduate students, along with their follow-up interviews. In addition to data collected from the undergraduate students, reports from TEE program faculty and online databases were used. Each research question, as outlined in Chapter I, are addressed sequentially with accompanying data and analysis as described in Chapter III.

Quantitative Findings

Data collected from undergraduate students through an online survey were analyzed to answer the following research questions:

1. What relationship, if any, exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and their:
    a. Interest in teaching TEE as a future career?

i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the interest in teaching as a future career.

b. Intention to complete their undergraduate TEE program?

i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the intention to continue in the undergraduate TEE program.

2. Is the effect of participation in TEECA on an undergraduate TEE student's interest in pursuing teaching as a future career moderated by:

a. Ability beliefs?

i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

b. Expectancy beliefs?

i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

c. Utility beliefs?

i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

3. Is the effect of participation in TEECA on an undergraduate TEE student's interest in completing their undergraduate TEE program moderated by:
    a. Ability beliefs?
        i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.
    b. Expectancy beliefs?
        i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.
    c. Utility beliefs?
        i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

Demographics

To investigate the research questions guiding this study, an online survey was distributed to undergraduate TEE students across the United States of America via program faculty members. In all, 97 students consented to participating in the survey. Of those 97 participants who began the survey, 72 students continued the survey and filled out the demographics. Of the 72 who provided demographics, 11 respondents did not complete any of the information on TEECA participation or future intentions. There was no clear defining demographic that was not responsive. Of those who provided demographic information, but did not continue the survey, 7 identified as male, 4 identified as female, and students were in various years in their post-secondary education (Table 3).

Table 3

Demographics of Survey Non-Completers (n = 11)

	Years in Post-Secondary Education		Years in TEE	
Year	*f*	%	*f*	%
1	3	27.2	5	45.5
2	2	18.2	3	27.2
3	3	27.2	1	9.1
4	2	18.2	2	18.2
5	1	9.1	0	0
Total	11	99.9	11	100

One participant provided information on TEECA participation but left one belief statement on course content unfilled. However, this participant's survey was still used to investigate teaching interest and persistent intentions.

Gender

The students were asked to share what gender they identify with. Most participants identified as male (*n* = 38) followed by 31 respondents identifying as female, two as non-binary/third gender, and one participant preferring not to say (Table 4).

Table 4

Self-described gender (N = 72)

Gender	*f*	%
Male	38	52.8
Female	31	43.1
Non-Binary/Third Gender	2	2.8
Prefer not to say	1	1.4
Total	72	100

Years in School

Students were asked to share how many years they had been attending college as well as how many years they had been enrolled in their undergraduate program. Most of the respondents were within their first 6 years of college with one respondent having been

in college for at least 10 years (Table 5). It is unclear if this participant was enrolled at the same university or if they had transferred universities at some point.

Table 5

Year in college the student was completing at the time of completing the survey (N = 72)

Year	*f*	%
1	14	19.4
2	16	22.2
3	18	25.0
4	15	20.8
5	5	6.9
6	3	4.2
10+	1	1.4
Total	72	100

All the students who responded to the survey were within the first 4 years of being enrolled in their current undergraduate program. While the participants were dispersed across four years within the program, the greatest proportion were participants who were completing the first year of the TEE program (Table 6). This data showed that the average number of years that a student had spent in post-secondary education was 2.96 years with a standard deviation of 1.59 whereas the average number of years students were enrolled in their current undergraduate TEE program was 1.94 years with a standard deviation of 1.12. The difference between average number of years in post-secondary education when compared to years in the undergraduate TEE program was

1.02 years, which suggested that many students were transfer students from other majors. However, it was unclear how many remaining years of study the students may still have had to complete.

Table 6

Year in the undergraduate TEE program the student was completing at the time of completing the survey (N = 72)

Year	*f*	%
1	24	33.3
2	17	23.6
3	17	23.6
4	14	19.4
Total	72	100

Future Career and Program Intentions

When the students were asked to respond to the statement "I am interested in teaching" the majority (n = 48) of participants ranked the statement as "Very True." There were 10 participants that rated the statement as "Somewhat True" while "Neither True or Untrue," "Somewhat Untrue," and "Very Untrue" were each selected once (Table 7).

Table 7

Students' interest in teaching (N = 61)

Interest Statement	*f*	%
Very True	48	78.7
Somewhat True	10	16.4
Neither True nor Untrue	1	1.6
Somewhat Untrue	1	1.6
Very Untrue	1	1.6
Total	61	99.9

Note. Eleven participants completed their demographics but did not respond regarding their belief and interest statements.

While 48 participants indicated high interest in teaching, when responding to the statement "I like teaching," 46 participants responded with "Very True." There was a slight increase in responses saying, "Somewhat True" (n = 12) and "Neither True nor Untrue" (n = 2) (Table 8).

Table 8

Student responses to like for teaching (N = 61)

Interest Statement	*f*	%
Very True	46	75.4
Somewhat True	12	19.7
Neither True nor Untrue	2	3.3
Somewhat Untrue	0	0
Very Untrue	1	1.6
Total	61	100

Note. Eleven participants completed their demographics but did not respond regarding their belief and interest statements.

Despite showing a slight variance of interest in pursuing teaching as a career, there was less variance in students' intent to graduate from their major. When responding to the statement "I plan to graduate from my major," 52 students responded with "Very True" (Table 9).

Table 9

Students' intentions to graduate from their undergraduate program (N = 61)

Interest Statement	*f*	%
Very True	52	85.2
Somewhat True	8	13.1
Neither True nor Untrue	0	0
Somewhat Untrue	0	0
Very Untrue	1	1.6
Total	61	99.9

Note. Eleven participants completed their demographics but did not respond regarding their belief and interest statements.

TEECA Participation

In providing information on TEECA Participation, students provided information about their participation in different aspects of TEECA. Students were asked how many TEECA competitions (both regional and national) they had previously participated in, how many conferences and/or competitions they had attended, the regularity of their

chapter meeting attendance, and how many years they had been a registered member of TEECA. From this information, students' level of participation in TEECA was determined based on the total number of activities they had participated in. The assigned levels ranged from zero to four. For example, students who may have attended chapter meetings and were registered members of TEECA but did not attend conferences or compete in competitions would be given a participation level of 2 (Table 10).

Table 10

TEECA participation levels (N = 61)

Participation Level	*f*	%
0	19	31.1
1	7	11.5
2	6	9.8
3	3	4.9
4	26	42.6
Total	61	99.9

Note. Eleven participants completed their demographics but did not respond regarding their belief and interest statements.

Relationship Between TEECA Participation and Student Intentions

To investigate the relationship between TEECA participation and students' interest in teaching, a Spearman's rho correlation was computed with the collected data.

There was a small positive correlation between the two variables, $r(59) = .18$. However, the relationship was not statistically significant, $p = .16$ (Table 11).

Table 11

Crosstabulation of participation level and interest in teaching (N = 61)

		Interested in Teaching					
		Very Untrue	Somewhat Untrue	Neither True or Untrue	Somewhat True	Very True	Total
Participation Level	0	1	0	0	5	13	19
	1	0	0	0	1	6	7
	2	0	1	0	0	5	6
	3	0	0	0	2	1	3
	4	0	0	1	2	23	26
Total		1	1	1	10	48	61

An additional Spearman's rho correlation was computed to investigate the relationship between TEECA participation and students' intentions to graduate from their TEE undergraduate program. There was a small positive correlation between the two variables $r(59) = .21$. This relationship also lacked statistical significance, $p = .10$ (Table 12).

Table 12

Crosstabulation of participation level and intent to graduate from major (N = 61)

		Plan to Graduate from Major			
		Very Untrue	Somewhat True	Very True	Total
Participation	0	0	5	14	19
Level	1	0	1	6	7
	2	0	1	5	6
	3	0	0	3	3
	4	1	1	24	26
Total		1	8	52	61

Moderation Analysis

While no statistically significant relationship was observed between TEECA and student intentions, moderating variables were investigated to look for any moderating affect that the belief values pulled from the FIT-choice scale within the Expectancy-Value Theory that are indicators of persistence. These items were ability beliefs, expectancy beliefs, and utility beliefs.

Exploratory Factor Analysis

As the items pulled from the FIT-choice scale were being used for a new content area and were focusing on potential pre-service teachers instead of in-service teachers, the items were modified. With this modification, an exploratory factor analysis was done to evaluate the factors used in the study. Below are the 11 variables used in the factor

analysis with their associated belief item and definition (to see the scales used, see the full instrument in Appendix B):

1. Ability belief: the participant's belief in their ability to perform the task.
    a. I have the skills and characteristics to succeed as a teacher.
    b. How would you rate your teaching abilities?
    c. If you were to list all the students in your program from worst to the best at teaching, how would you rank yourself?
    d. Compared to other subjects outside of your major (general education) how did you perform in your major content courses?
2. Expectancy Belief: the expectancy of personal success at the task
    a. How well do you expect to do in your major courses this year?
    b. How would you rate your ability to learn something new in your content area?
    c. How would you rate your ability to teach within your content area?
3. Utility Belief: the value of the task in contributing to society.
    a. Teachers are influential in society.
    b. Teachers shape adolescents' values.
    c. Teachers are influential on students' college or career choices.
    d. Teachers make a worthwhile contribution.

From the exploratory factor analysis, it was determined that these variables should remain within three factors. When looking at the three emerging factors, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.76 with a statistical significance ($p < 0.001$), indicating that the sample size was adequate to identify the new factors (Fabrigar & Wegener, 2011).

Factor one was comprised of five items that were reported on a 5-point Likert scale. These explained 30.21% of the variance with factor loadings from 0.54 to 0.87. Factor two was comprised of four items that were reported on a 5-point Likert scale that explained 19.60% of the variance with factor loadings from 0.66 to 0.80. Factor three loaded two items reported on a 5-point Likert scale and explained 11.03% of the variance with factor loadings from –0.60 to 0.76 (Table 13). Factor three was removed as the items identified had a large variance with little alignment to the other factors.

Table 13

Rotated exploratory factor analysis results for belief items

	Factor loading			
	1	2	3	Communalities
How would you rate your teaching abilities?	**0.87**			0.76
How would you rate your ability to teach within your content area?	**0.85**			0.74

If you were to list all the students in your program from worst to the best at teaching, how would you rank yourself?	**0.70**			0.51
I have the skills and characteristics to succeed as a teacher	**0.57**	0.44		0.52
How would you rate your ability to learn something new in your content area?	**0.55**	0.33	0.30	0.50
Teachers are influential in society		**0.80**		0.63
Teachers make a worthwhile contribution		**0.78**		0.68
Teachers shape adolescents' values		**0.76**		0.58
Teachers are influential on students' college or career choices		**0.67**	-0.34	0.570
How well did you expect to do in your major courses this year?	0.32		**0.76**	0.68
Compared to other subjects outside your major (general education) how did you perform in your major content courses?	0.40		**-0.60**	0.53
Eigenvalue	3.32	2.17	1.21	
% of Variance	30.21%	19.60%	11.03%	
Cumulative %	30.21%	49.81%	60.84%	

Note. All scores below 0.3 are not shown.

The Utility Belief factor was the only grouping that was not altered from the originally associated grouping by the factor analysis. Since the second factor identified contained three of the Ability Belief items with two Expectancy Belief items, the second factor was named Ability-Expectancy Belief. Reliability was found for both the intended factors and for the factors identified in the factor analysis. Both factors found in the exploratory factor analysis showed acceptable reliability (Table 14).

Table 14

Reliability of original factors and modified factors from the factor analysis

Original FIT-Choice Factor	Items	α
Ability Belief	1a, 1b, 1c, 1d	.62
Expectancy Belief	2a, 2b, 2c	.58
Utility Belief	3a, 3b, 3c, 3d	.75
Modified Factors	Items	α
Ability-Expectancy Belief	1a, 1b, 1c, 2b, 2c	.78
Utility Belief	3a, 3b, 3c, 3d	.75

Moderation Analysis Results

The moderation analysis evaluating the moderating impact of Ability-Expectancy Beliefs on the relationship between participation in TEECA and undergraduate students' interest in teaching fell short of statistical significance, $F(2, 58) = 1.71$, $p = .19$, $R^2 = .02$. An additional moderation analysis found no statistical significance on the moderating effect of Utility Beliefs between participation in TEECA and undergraduate students' interest in teaching, $F(2, 58) = 1.61$, $p = .21$, $R^2 = .02$.

The moderating impact of Utility Beliefs on the relationship between participation in TEECA and undergraduate students' intentions to graduate from the major fell short of statistical significance, $F(1, 59) = .84$, $p = .36$, $R^2 = -.003$. Additionally, Utility Beliefs impact on the relationship between participation in TEECA and undergraduate students'

interest in pursuing teaching did not have statistical significance, $F(1, 59) = .01$, $p = .91$, $R^2 = -.02$

Statistical Power

A priori power analyses were conducted using G*Power version 3.1 (Faul, et al., 2009) to determine the minimum sample size required to test the hypothesis of this study. This analysis was conducted for both the correlation analysis and moderation analysis.

Correlation Power Analysis

The results from the power analysis indicated that the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = 0.05$, was $N = 64$ for a Spearman's rho correlation model. A post-hoc analysis indicated that this study achieved 78% power for detecting medium effect at a significance criterion of $\alpha = 0.05$ with the sample size acquired ($N = 61$).

Moderation Analysis Power Analysis

The results from the power analysis indicated that the required sample size to achieve 80% power for detecting a medium effect ($f^2 = .15$), at a significance criterion of $\alpha = 0.05$, was $N = 55$ for a moderation analysis that utilized a linear multiple regression with one predictor. A post-hoc analysis indicated that this study achieved 85% power for

detecting a medium effect at a significance criterion of $\alpha = 0.05$ with the sample size acquired ($N = 61$).

Additional Findings

The relationships between the belief factors and undergraduate TEE students' interest in pursuing teaching as well as their intent to complete their undergraduate program were also investigated. As the data were measured on an ordinal scale, but nonparametric, a Spearman's rho correlation was chosen for the statistical analysis (Table 15).

Table 15

Spearman's rho correlation for belief items and students' future intentions

	1	2	3	4
1. Interest in Teaching	-			
2. Intentions to graduate from major	.33**	-		
3. Ability-Expectancy Beliefs	.25	.32*	-	
4. Utility Beliefs	.32*	.45**	.01	-

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

A positive correlation was found between Ability-Expectancy Beliefs and an undergraduate student's intentions to graduate from their major $r(59) = .32$, $p = .01$.

Additionally, a positive correlation was found between a student's Utility Beliefs and an undergraduate student's intentions to graduate from their major $r(59) = .45$, $p < .001$, as well as their interest in teaching $r(59) = .32$, $p = .01$.

Influential Student Experiences

Responses were collected through semi-structured interviews with eight undergraduate TEE students across six different programs across the United States of America. The interviews were coded to identify influential experiences from participation in TEECA and in the undergraduate TEE program on student's persistence intentions and teaching interests. The coded interviews helped to answer the following research question:

What experiences from participation in pre-professional communities of practice do students recognize as influential in their interest in teaching TEE as a future career as well as their intent to continue in their undergraduate program?

Demographics

All eight students who participated in the follow-up interviews were undergraduate students who intend to pursue teaching as a career following graduation. These students came from six different programs across the nation ranging from

freshman in their first year of college to students who had just completed their undergraduate degree (Table 16). One student was completing their first year of the program and had no experience with TEECA, but the other seven participants had participated at varying levels. This participation included three students participating as officers for their university chapter and competing in events, two additional students having competed in competitive events, and two students who explained they have yet to participate beyond being a member but showed interest and excitement in doing so.

Table 16

Interview participant descriptions

Participant	Description
Participant One	Participant One was in his first year in his undergraduate TEE program. He transferred schools to pursue technology education since there was no TEE undergraduate program offered at the school he had previously attended. While he did not credit TEECA to having an influence on his future intentions, he enthusiastically endorsed participation in TEECA as a method to build friendships and camaraderie with peers.
Participant Two	Participant Two was entering his senior year at the time of the interview. He had transferred to his university to enroll in his university's TEE undergraduate program. He expressed a love for TEECA and participating in the club, but due to some conflicts with peers, he discontinued his participation. He explained that participation in the TEECA club allowed him to practice and learn skills that he does not think he would have been able to learn if it wasn't for the challenges extended in the competitive events.
Participant Three	Participant Three had just graduated one month prior to the interview and had a teaching position lined up for the following

	year. Her participation in TEECA consisted of competing in a competitive event at the request of her undergraduate program faculty. She said that TEECA participation did not influence her future career intentions or teaching interests, but it did help her to hone her skills. She had taken CTE courses in high school and was considering education as a career but did not consider a TEE undergraduate program until she was trying to select a major and was looking over all undergraduate degrees her university offered.
Participant Four	Participant Four had been enrolled in secondary education programs for over ten years but was in his first year enrolled in his current university and undergraduate TEE program. He explained that after years of school, he chose to pursue a career in education and did not know Technology and Engineering Education existed until looking up undergraduate programs from different universities in the state he resides in. He knew little about TEECA prior to the interview and is undecided if he intends to participate in the future.
Participant Five	Participant Five had just completed her sophomore year prior to participating in the interview. She enrolled in her university knowing she wanted to pursue education but did not know about the undergraduate program until speaking to a faculty member who introduced her to the program and the TEECA club. She had participated in TEECA for one year and said participation helped her narrow down her interests in what she may want to teach in the future. Additionally, she enjoyed that participation allowed her to meet more students in her undergraduate degree.
Participant Six	Participant Six was a freshman at the time of the interview and had not participated in TEECA prior to the interview. However, she expressed her intentions to participate in competitive events during the 2023-2024 year. Her high school teacher recommended the undergraduate TEE program that she was enrolled in. During the school tour prior to enrollment, TEECA club members were enthusiastic about the club, which was influential in her ultimately choosing the university she chose to attend.
Participant Seven	Participant Seven joined his TEE undergraduate program as a freshman but was a senior in his program at the time of the interview. He has participated in both regional and national

	TEECA competitive events. He admitted he did not participate in TEECA as a freshman because the Covid-19 pandemic led to the competitive events to being online, which he was not interested in. Participation in TEECA was appealing to him to be more engaged in the classroom and labs of her program. He explained that he chose to pursue education because he grew up around a lot of educators and recognized the impact that his high school teachers had on him and felt called to that field.
Participant Eight	Participant Eight chose to pursue technology education from taking technology courses in secondary education and from experience coaching in other activities. He was introduced to TEECA during an introduction seminar for his major. He was initially interested in the relationships that could be developed through participation. The participant has participated in regional and national TEECA competitions and credited TEECA with influencing what content he may want to teach in the future.

Influence of TEECA Participation on Future Interests

No student noted that TEECA had an influence in them choosing to pursue teaching as a career. However, three participants noted that TEECA may have influenced the specific subject area that they may want to teach in. Participant One shared his interest in pursuing a teaching position within higher education and keep TEECA as an active part of the program saying, “I would love to bring TEECA in to positively impact college students like I have been. I mean, it hasn’t influenced whether or not I’m going to be a shop teacher, but just that aspect.”

Participant Eight explained how TEECA helped him to identify areas within TEE he hadn't previously considered saying:

> I've definitely noticed some of my strong suits as far as what courses I would prefer to teach... Right now, we're prepping for our [regional TEECA competition] where we are all kind of doing a bunch of different things, but like I said before, we're doing manufacturing, robotics, and we're doing transportation, so there's a whole bunch of different avenues where I'm able to dip my toe into... I definitely feel like TEECA has helped mostly by giving those opportunities.

Participant Six recognized that she always had an interest in teaching technology but acknowledged she thinks TEECA may help to shape her decision in what specifically to teach within technology education. Additionally, Participant Six added that when choosing which university to attend, she chose their program because of recommendations from high school teachers as well as wanting to experience the excitement from participation in TEECA that the current students showed.

Benefits of TEECA Participation

While students did not feel that TEECA participation directly influenced their intentions to pursue teaching or graduate from their undergraduate program, various benefits of TEECA participation were identified in the interviews. Benefits that were identified included friendships that were developed, an opportunity to practice skills outside of class assignments, networking, and positive experiences within the field.

Three participants made a reference to TEECA helping them to develop a core group of friends within their program. Participant One noted that participation in TEECA offers a setting for students in the major to develop relationships, explaining that "working on competitions has been awesome... I guess just being all stressed out together kind of helped us to bond." However, Participant Two expressed disappointment because while he had developed friendships, developed technical skills, and had many positive experiences through TEECA participation that brought them "lots of joy to [their] life," he chose to step back from TEECA because of a negative experience with other students in their program. Friendships, or strengthened relationships, were some of the most mentioned benefits that came from TEECA participation.

In addition to friendships and connections developed with peers in the program, professional networking is afforded to participants who participate in conference attendance. This was apparent in Participant Seven's response saying:

> It's not just about competing, but you're also networking. That's something that has really helped me coming to college. I was a lot more introverted, and then just like the last few years I've just become a little more outgoing, but getting to talk to not only your peers as university students, but professionals in education and in actual jobs in the work force, that's been super beneficial... I think that TEECA has really helped me not only grow as a student and teacher, but as a communicator. It has helped me learn a lot.

As this study was limited to undergraduate students currently going through their program, long-term benefits of TEECA participation were outside of the scope of this

study. Additionally, while Participant Two expressed negative experiences from participation in TEECA, there were no interview questions exploring detriments or drawbacks from TEECA participation.

Undergraduate Program Selection

While the interviews focused on TEECA participation and outcomes identified by student participants, one theme that emerged was how students chose to pursue teaching or chose their undergraduate program. All the participants had a different route leading them to pursue becoming a technology and engineering educator. Four of the eight participants mentioned a teacher or family member recommended a program. Five participants noted that they enjoyed previous experiences in their high school shop or technology classes that led them to an interest in the field. The other three participants found the program by having an interest in teaching and explored many different education fields, describing an exhaustive search.

Participant Three explained that they struggled knowing what she wanted to do and chose teaching because she enjoyed being with people. However, she had no idea what to teach. She explained the process of pulling up a list of every major at the university and going down alphabetically until they landed on Technology and Engineering. She went on to say that it sounded fun, but she was weary because she didn't really enjoy math. Ultimately, she decided that the undergraduate program could

still be fun, so she “just went full send and did it.” Participant Three also noted that she loved their program and had no regrets in doing the program.

Similarly, Participant Four explained that he decided they wanted to become a high school teacher after taking their general courses part-time over the course of 10 years. Participant Four also had no idea what he wanted to teach but began looking up programs within the state. He knew that he did not want to teach English and Math but didn’t know what else was out there. He found the TEE program by looking up a list of programs at each university in the state. He then looked up TEE to explore what that entailed. He decided that they “like tech and computer stuff,” so he chose to explore the TEE field. From a continued internet search, he concluded that the school that listed the TEE program was the only TEE program in the state, so he chose to attend that university. It was not until after he began attending the university that he found out another university in the state offered TEE but found himself enjoying the program and happy where he ended up.

The Greater Good

Two students mentioned wanting to pursue education to help the rising generation. Participant Seven showed an altruistic pull towards STEM education. He described this by saying,

> Throughout high school, I got to see the teachers that made an impact on my life that pushed me to be a good student. I just wanted to be like them. Personally, I haven't had a ton of experience with unsuccessful or bad teachers. But I know that there are some and I just thought that I have the right skill set, and the mindset, to be a good teacher. I just want to help educate the next generation, and particularly in STEM education. It's kind of dying out in some ways. Either the funding or the interest just isn't there, but STEM is such an important content area to teach because it's directly applied to jobs. It ties into everything, but enrollment is going down in [the area I'm from] so I just felt called to teach tech ed and grow that field.

Participant Eight described previous teaching experiences through previous volunteer positions that helped him grow a love for education. He shared that he found pride in helping others to develop skills and found that he wanted to share his love for industrial arts like he had in school.

Contextual Factors of TEE Programs

The following findings were collected by contacting program faculty from TEE programs that had TEECA affiliation in the past ten years. In addition to the responses from program faculty, published data were utilized to answer the research question:

What are the contextual factors of technology and engineering undergraduate programs that may influence current and potential TEECA members' perception and understanding of the TEE field?

Program Synthesis

The initial search in the National Center for Education Statistics (NCES) database produced 76 universities that have programs listed under the Technology/Industrial Arts Teacher Education CIP code. Love and Maiseroulle (2021) listed 74 in their analysis of current STEM programs, however, they noted that three of these programs have been discontinued. From cross-referencing the NCES data and the Love and Maiseroulle data, a total of 110 Technology and Engineering teacher preparation programs were included on the final list (Table 17). It remains unclear which of these programs are active, the content taught, and what kind of certification they provide (i.e., secondary education, elementary education, STEM endorsement). Additionally, from these 110 programs, sixteen have been affiliated with TEECA in the past 10 years.

Table 17

Love and Maiseroulle's (2021) vs NCES comprehensive list of programs

Love and Maiseroulle's List	NCES List
Appalachian State University* †	Ball State University
Augusta University*	Bemidji State University*
Ball State University†	Berea College
Berea College	Black Hills State University
Black Hills State University**	Boise State University*
Brigham Young University*†	California State Polytechnic University-Humboldt*
California State University, Los Angeles	California State University-Los Angeles
California University of PA*†	Casper College
Casper College (2+2 with Valley CityState)	Central Connecticut State University

Central Connecticut State University†	Central New Mexico Community College*
Central Washington University*	Cerritos College*
Colorado State University*	Chadron State College*
East Tennessee State*	Chicago State University*
Eastern Illinois University*	Clemson University*
Eastern Kentucky University	CUNY City College*
Eastern Michigan University	CUNY New York City College of Technology*
Fitchburg State University†	Delta College*
Florida A&M University*	Dickinson State University*
Fort Hays State University†	Eastern Kentucky University
Hofstra University	Eastern Michigan University
Illinois State University†	El Camino Community College District*
Indiana State University	Fitchburg State University
Jackson State University	Fort Hays State University
Kansas State University, Polytechnic Campus* **	Fox Valley Technical College*
Lebanon Valley College*	Fresno City College*
McDaniel College*	Fullerton College*
Millersville University of PA*†	Hofstra University
Montana State University*	Illinois State University
Morehead State University*	Indian Hills Community College*
Murray State University*	Indiana State University
New Jersey Institute of Technology*	Jackson State University
New York City College of Technology*	Lakeland University*
North Carolina A&T University*	Lincoln University*
North Carolina State University†	Loyola University Chicago*
Northern Michigan University	Loyola University Maryland*
Ohio Northern University†	Marian University*
Old Dominion University†	North Carolina State University at Raleigh
Pittsburg State University†	Northern Michigan University
Purdue University†	Ohio Northern University
Rhode Island College†	Old Dominion University
Savannah State	Pennsylvania Western University*†
South Carolina State University	Pittsburg State University
St. Catherine University*	Purdue University-Main Campus
St. Cloud State University*	Rhode Island College
SUNY Buffalo†	Rider University*
SUNY Oswego*†	Saint Cloud State University*
Texas A&M*	San Francisco State University*

The College of New Jersey	Savannah State University
The Ohio State University*	South Carolina State University
Tufts University*	State University of New York at Oswego
University of Arkansas*†	SUNY Buffalo State University
University of Central Missouri*	The College of New Jersey
University of Georgia*	University of Idaho
University of Idaho	University of Maine*
University of Maryland Baltimore County	University of Maryland Eastern Shore
University of Maryland Eastern Shore	University of Maryland-College Park
University of Nebraska-Lincoln*	University of New Mexico-Main Campus*
University of Nebraska-Omaha*	University of Northern Iowa
University of Northern Iowa	University of Puerto Rico-Carolina*
University of St. Thomas*	University of Southern Maine*
University of Texas El Paso*	University of Washington-Seattle Campus*
University of Wisconsin, Oshkosh*	University of Wisconsin-Platteville
University of Wisconsin, Parkside * **	University of Wisconsin-Stout
University of Wisconsin, Platteville	University of Wyoming
University of Wisconsin, Stout	Utah State University
University of Wyoming†	Valdosta State University*
Upper Iowa University*	Valley City State University
Utah State University†	Vincennes University*
Valley City State University	Viterbo University
Virginia Tech*	Wayne State College
Viterbo University	West Chester University of Pennsylvania*
Wayne State College	Western Michigan University
Western Michigan University	Western Washington University*
William Penn University	Westfield State University*
	Widener University*
	William Penn University

* Universities that are unique to the list and not shared on both lists
**Love and Maiseroulle noted that these programs have been discontinued
† Programs that have had TEECA affiliation in the past ten years. Programs are only marked once if they are listed on both lists.

Program Information

The information provided by the faculty of various TEE programs that were affiliated with TEECA in the past 10 years across the United States of America showed variations that exist in the titles, size, and type of programs that exist to prepare teachers in the field of technology and engineering education. The following descriptions were provided by the faculty of the programs.

Description of School Programs

Brigham Young University: The program was called Technology and Engineering Education until 2019 and was solely a teacher licensure program. In 2020, it was transitioned to Technology and Engineering Studies with an emphasis in education.

The College of New Jersey: Their program is under the Department of Integrative STEM. Within this department there are two majors for technology education. These majors are Technology and Engineering Education and the iSTEM major. The Technology and Engineering Education major leads students to a secondary teaching certificate to teach technology education in the state of New Jersey. The iSTEM major is a joint major between the School of Elementary Education and Engineering. Teachers in iSTEM can choose to pursue a STEM specialization. The technology specialization certifies students to teach technology education in the state of New Jersey in grades kindergarten through 12th grade.

Fort Hays State University: Their undergraduate program is in the Department of Applied Technology. The undergraduate degree is Technology Studies with a concentration in Technology Education for those pursuing licensure.

Illinois State University: The program is Technology and Engineering Education and is intended solely for those pursuing secondary teaching licensure from their program.

Millersville University: The program is Technology and Engineering Education which will lead students to teaching licensure for grades Pre-Kindergarten through 12th grade.

North Carolina State University: The program is Technology, Engineering, and Design Education. Within this program there is the pathway to teaching licensure as both an undergraduate major and minor degree. There is also the Technical Graphic Communications minor that has over 200 undergraduate students enrolled in it.

Ohio Northern University: The program is Technology Education and trains all students for teacher licensure. However, students can opt out of student teaching and not receive a teaching license.

Old Dominion University: This program is an emphasis of the Career and Technical Education Bachelor's degree. Within this degree, students can choose to graduate in Technology Education or Marketing Education.

PennWest California: As of the 2022-2023 academic year, due to drops in enrollment in teacher preparation programs, this program is now a degree in Secondary Education with a concentration in Technology Education. Previously, it would have been a Bachelor of Science in Technology Education.

Pittsburg State University: This degree is a Bachelor's degree in Career and Technical Education with an Emphasis in Technology and Engineering Education.

Purdue University: This program is titled Engineering and Technology Teacher Education and is intended solely for those pursuing secondary teaching licensure from their program.

The State University of New York – Oswego: This program has two degrees for undergraduate students. One is an industry track called Technology Management, and the teaching track is called Technology Education.

Utah State University: The program is Technology and Engineering Education and is intended solely for those pursuing secondary teaching licensure from their program. As of August 2023, their program has added a stackable program that is

connected to technical colleges in the state to help those with technical degrees and certificates receive teacher licensure in secondary education.

Program Enrollment and TEECA Affiliation

Along with the variety of programs that exist within the TEE field, enrollment numbers between programs ranged from seven to 175 (Table 18). The program that reported the highest enrollment was The State University of New York-Oswego which reported an enrollment of 175 students with 135 students pursuing teaching licensure. There were two programs that reported seven students enrolled with all seven pursuing teaching licensure. The largest difference of enrollment versus those pursuing teaching licensure was Fort Hays State University who reported 170 students enrolled with ten of the students pursuing teaching licensure. Of the thirteen programs that responded, six programs had enrollment of over 50 students. However, of those six programs, three of them have over 50 students pursuing education licensure. Four of the programs reported having enrollment of 100 students or above.

Table 18

Status of TEECA affiliation and enrollment numbers

School Name	Last TEECA Affiliation	Total Students enrolled	Number of Students Pursuing Licensure

Brigham Young University	Current	75	29
The College of New Jersey	Current	25 TEE Majors 75 iSTEM Majors	100
Fort Hays State University	Current	170	10
Illinois State University	Current	32	32
Millersville University	Current	60	60
North Carolina State University	Current	101	27
Ohio Northern University	Current	7	7
Old Dominion University	2018	7	7
PennWest California	Current	19	19
Pittsburg State University	Current	20	20
Purdue University	Current	19	19
The State University of New York - Oswego	Current	175	135
Utah State University	Current	16	16

Note. There was no response from Appalachian State, Central Connecticut State University, Fitchburg State, Rhode Island College, The State University of New York – Buffalo State University, University of Arkansas, and University of Wyoming

Summary

This section outlined the findings from this research study according to the research questions presented. Correlation and moderation analyses were used to investigate aspects of the relationship between participation in TEECA and an undergraduate student's intentions to pursue teaching as well as graduate from their undergraduate TEE program. No statistical significance was found in both the correlation as well as the moderation analyses. Responses from program faculty as well as university program information from previous reports and national databases were used to identify the status of programs across the nation.

Conclusions that can be drawn from the findings presented in this study along with suggestions for practice and future research surrounding TEECA participation and TEE programs will be discussed in Chapter V.

CHAPTER V

CONCLUSIONS AND DISCUSSION

Introduction

The field of technology and engineering education has evolved in many ways throughout the years. These evolutions have included changes of identity, name, and expanding the content to stay relevant with and prepare students for the developing technological industry. The field of TEE has struggled with the implementation of some of these changes due to differences in CTE policy between states, philosophical differences or disagreements among program faculty, and local needs. One struggle amongst these changes is the inability for TEE programs across the nation to adapt to changes consistently across the field. Along with the implementations of these changes, research studies and members of the TEE community have noted the decline of TEE teacher preparation undergraduate program and their enrollment, contributing to a deficit of TEE teachers entering the workforce.

Previous studies have identified reasons why some teachers enter the field of education as well as qualities that encourage teachers to persist as educators. Some qualities that have been shown to influence persistence include their perceived ability beliefs, expectancy beliefs, and utility beliefs. Additional studies have shown that pre-

professional organizations acting as communities of practice during undergraduate programs help foster undergraduate students' persistence. However, there remains a lack of studies investigating recruitment and retention of students in undergraduate technology and engineering programs that offer teaching licensure. The purpose of this study was to investigate five research questions surrounding the influence of TEECA on undergraduate technology students' interest in pursuing teaching and intentions to graduate from their undergraduate program.

1. What relationship, if any, exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and their
    a. Interest in teaching TEE as a future career?
        i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the interest in teaching as a future career.
    b. Intention to complete their undergraduate TEE program?
        i. Hypothesis$_0$: No relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the intention to continue in the undergraduate TEE program.
2. Is the effect of participation in TEECA on an undergraduate TEE student's interest in pursuing teaching as a future career stronger with increased

a. Ability beliefs?

    i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

b. Expectancy beliefs?

    i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

c. Utility beliefs?

    i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

3. Is the effect of participation in TEECA on an undergraduate TEE student's interest in completing their undergraduate TEE program stronger with increased

    a. Ability beliefs?

        i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

    b. Expectancy beliefs?

i. Hypothesis$_0$: Expectancy beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

c. Utility beliefs?

i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

4. What experiences from participation in pre-professional communities of practice do students recognize as influential in their interest in teaching TEE as a future career as well as their intent to continue in their undergraduate program?
5. What are the contextual factors of technology and engineering undergraduate programs that may influence current and potential TEECA members' perception and understanding of the TEE field?

Considering the findings from the statistical tests and analyses produced from this investigation explained in Chapter IV, this chapter presents the conclusions with an interpretation of the results, along with implications for practice and future research. Additional observations stemming from the findings of this study that may not directly address the research questions, but are worth noting, will also be discussed in this chapter.

Research Question One

Research question one first sought to investigate what relationship, if any, exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and their interest in teaching TEE as a future career. The null hypothesis for this investigation was that no relationship exists between an undergraduate TEE student's involvement with the pre-professional organization TEECA and the interest in teaching as a future career. The correlation analysis found no statistically significant relationship between participation in TEECA and participants' interest in teaching as a future career. Therefore, the null hypothesis was retained.

The second part of research question one was to investigate what relationship, if any, exists between undergraduate TEE students' involvement with the pre-professional organization TEECA and their intention to complete their undergraduate TEE program. The null hypothesis for this investigation was that no relationship exists between undergraduate TEE students' involvement with the pre-professional organization TEECA and their intent to continue in the undergraduate TEE program. The null hypothesis was again retained with the correlation analysis showing no statistical significance.

For both parts of research question one, it should be noted that statistical significance was not achieved. A larger sample could potentially allow for a statistically significant correlation for these relationships to be identified.

Research Questions Two and Three

Research questions two and three sought to look at the moderating impact of beliefs on the relationship between an undergraduate student's participation in TEECA and their intent to pursue teaching as a career as well as their interest in completing their undergraduate degree. The three beliefs observed in this study were expected to be ability beliefs, expectancy beliefs, and utility beliefs, as identified by previous studies utilizing the FIT-Choice Scale as indicators of persistence in previous studies. From the factor analysis, two beliefs emerged. The beliefs applied in this analysis were ability-expectancy beliefs and utility beliefs. The utility belief remained the same with the original factors from the FIT-Choice Scale. However, the ability-expectancy belief construct was a mix of the intended ability and expectancy belief factor with some items removed. As the construct that emerged included both ability and expectancy belief items, this construct was named "Ability-Expectancy Beliefs."

The original belief factors used from the FIT-Choice scale were modified because of the EFA. Due to the modified belief factors that resulted from the EFA, research questions two and three with the null hypotheses were altered as follows;

1. Is the effect of participation in TEECA on an undergraduate TEE student's interest in pursuing teaching as a future career stronger with increased:
    a. Ability-Expectancy beliefs?

i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

b. Utility beliefs?

i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their interest in teaching as a future career.

2. Is the effect of participation in TEECA on an undergraduate TEE student's interest in completing their undergraduate TEE program stronger with increased:

a. Ability-Expectancy beliefs?

i. Hypothesis$_0$: Ability beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

b. Utility beliefs?

i. Hypothesis$_0$: Utility beliefs have no moderating effect on TEE undergraduate students' involvement with TEECA and their intention to complete their undergraduate TEE program.

As the moderation analysis lacked statistical significance, as shown in chapter IV, the null hypotheses for research questions three and four were retained.

Additional Correlations

The correlations computed looking at teaching interest, intent to graduate from the major, Ability-Expectancy Beliefs, and Utility Beliefs indicated that students with stronger beliefs in their abilities to perform in the major content as well as teaching abilities, students ranked their intentions to graduate from the major higher. Additionally, with stronger Utility Beliefs, students indicated higher interest in pursuing teaching as well as increased intent to graduate from their major. These findings suggest the relationship between the belief items identified in this investigation and students' future intentions merits further investigation.

Research Question Four

Identified Themes

The fourth research question sought to investigate what experiences from participation in pre-professional communities of practice students recognize as influential in their interest in teaching as a career as well as their intentions to continue in their undergraduate program. Interviews with students identified some emergent themes regarding impacts on future intentions from participation in TEECA.

Program Selection

One student identified TEECA as being influential in program selection. While it did not influence their interest in teaching or their intent to complete their undergraduate program, they did explain when choosing which university program to attend, the appeal of their undergraduate TEE program's TEECA chapter was a deciding factor for them.

Exposure and Experience

Three participants identified that participation in TEECA provided opportunities to grow in areas that they may not have previously considered teaching. Students may have enrolled in their program with the intent to teach a specific subject or area within TEE, but participation in TEECA afforded them the opportunity to explore and develop proficiency in additional TEE content areas.

In addition to educational experiences, one student mentioned that TEECA provided the opportunity to network and build connections. While networking was not an aspect within communities of practice that was investigated in this project, future research may benefit from looking at the long-term benefits of connections built through participation in TEECA. The connections built through conference attendance, competitive event participation, and regular chapter activities (i.e., guest speakers or service activities) may provide lasting relations to benefit students when transitioning into their professional careers.

Program Visibility

While this investigation did not seek to understand TEE teacher preparation program visibility, many students mentioned not knowing a TEE program existed at their university, or programs not being easy to find. Despite some students having taken technology and engineering classes throughout their secondary education experience, it was not a profession or undergraduate program of study that they were aware of. With the influence of TEE teachers being an influential factor for students pursuing teaching, the lack of awareness may suggest that TEE teachers do not suggest or address teaching technology and engineering as a legitimate or viable future career. For those programs with high enrollment numbers, it may be beneficial to understand what outreach and marketing practices they currently utilize to reach potential students, including how TEECA activities are utilized.

Research Question Five

The last research question sought to understand the contextual factors that impact current and potential TEECA members' perceptions and understandings for the TEE field. This study identified confusion in program cataloging and inconsistencies between undergraduate programs, exemplifying the struggles within TEE that may impede potential students from finding or pursuing a degree in TEE.

Program Cataloging

From cross-referencing the list compiled by Love and Maiseroulle (2021) and the NCES list, many inconsistencies are revealed. Love and Maiseroulle extended their list to graduate programs as well as technical degrees and certification programs. Their list also included 47 programs that were identified from ITEEA's directory. Additionally, they noted that some programs they had listed were discontinued.

It is unclear how many programs listed from the NCES data may be discontinued but may still be in the university's catalog. In addition to Technology Teacher/Industrial Arts Education, there may be additional CIP codes for teacher training programs within technology and engineering education that have been used. No CIP code exists for technology and engineering teacher preparation. Some programs may choose different CIP codes to categorize their program (i.e., Technical Teacher Education or Educational/Instructional Media Design).

Improved cataloging with a clear identification of which programs exist across the nation and what courses the graduates are certified to teach could be done to fully understand the actual status of TEE. While Volk (2019) has argued that the field is in decline, with few programs surviving, Love and Maiseroulle's rebuttal concluded that determining the number of TEE teacher preparation programs that exist is complex. Until

a determination can be made of existing and active TEE programs, the status of the TEE field remains unclear.

Current Status of Programs

The responses that were received from TEE program leaders revealed that TEE programs across the nation differ in enrollment, structure, and licensure offering. The programs that reported having 100 students or more enrolled had varying program structures. The College of New Jersey expanded its TEE program to include a STEM certification for elementary educators. While Fort Hays State University reported having an enrollment of 170 students, only 10 (5.88%) of those students were pursuing teaching licensure. Similarly, The State University of New York – Oswego has an industry track for their major, but 135 of their 175 (77. 14%) enrolled students were pursuing education licensure. North Carolina State University has grown its program by both offering a Technical Graphics Communication minor as well as an education minor. Each program with high enrollment numbers has found a different structure to help support its program.

While this study touches on some differences that exist amongst programs, future studies may help to support a deeper understanding of inconsistencies that may exist across programs across the nation. Litowitz (2014) touched on curricular similarities of TEE programs, but further studies may help to reveal which areas within technology, engineering, and vocational arts undergraduate students receive emphasis in terms of

specific content students are being trained to teach. It is unclear how transferable the skills and knowledge would be between undergraduate programs.

Impact of Type of Undergraduate Program

With each program being structured differently, knowledge and skills learned in one TEE program may have a vast difference from other TEE programs in the nation. These variations may exist from program to program as well as by state according to the state standards and objectives for technology and engineering education. These differences may be impacting the strength of the TEE programs. With some undergraduate programs being industry track with the option to pursue teaching licensure, further research may help to inform if that is impacting student licensure. Faculty members suggested that they altered their program structure because of low enrollment rates. However, it is unknown whether having an industry track pulls students who may have completed an education degree out of that career path.

Recommendations for Future Research and Practice

This section will offer suggestions for future research. While this data produced enough responses to detect a medium effect size for all the statistical analyses, a larger

number of respondents could be beneficial in establishing the practical significance of TEECA participation.

Impact of TEECA on Non-teaching Track Students

While a statistically significant relationship between participation in TEECA and an undergraduate student's interest in pursuing teaching TEE or their intention to complete their undergraduate program was not found, additional studies may help to identify aspects within TEECA that lead to recruitment and retention. Most of the participants in the study identified themselves as being interested in teaching as a career. However, some undergraduate TEE programs are industry-track programs that have an emphasis or pathway for teaching licensure. Students enrolled in an industry-track intend to pursue a career in commercial industry using the skills and knowledge from their content area, as opposed to pursuing a career in education. It is unclear how many industry-track students this survey may have reached. It is also unclear how many non-TEE students participate in TEECA within each chapter. While a university must have an undergraduate TEE program to have TEECA affiliation, attendance and participation in competitive events are often open to all majors. Some students participating in TEECA may not have been reached by the study as they may not have been an undergraduate TEE student but were still an undergraduate student participating in TEECA. After the initial request to faculty to distribute the survey to undergraduate students in their

programs, some faculty members requested clarification if it was only for students pursuing education or if the survey was intended for any of their students. Additional studies may help to identify what impact participation in TEECA has on undergraduate students in general, and their interest in pursuing a career in TEE. Additionally, with the limited number of non-teaching track students who participated in the study, further research may benefit from looking specifically at students enrolled in an undergraduate technology program that offers licensure but who are pursuing an industry-track.

As communities of practice are intended to contribute to long-term support and learning within a field, participation in TEECA may be a contributing factor to persistence. As this study did not investigate the long-term impacts of TEECA participation, a longitudinal study observing teachers that have entered the field of education along with their level of TEECA participation would help to inform stakeholders and programs of the impact of participation in TEECA as a community of practice on persistence in the field of education. Participation may contribute to teachers feeling more prepared when entering the field, which could assist in the prevention of attrition of new and veteran teachers.

Regional TEECA Participation

Along with the evolving field of TEE, TEECA has also had some variations in how it has functioned throughout the years. While there are yearly advisor meetings, this

study did not seek to understand the benefits or goals sought by advisors for their students through TEECA participation. While some faculty mentioned participation in regional TEECA events, regional events are not available to all students across the nation. Technology Education programs in the eastern half of the United States of America have access to regional conferences as well as the national conference. This study did not look at the impact of regional participation as opposed to national participation. Future studies may help to inform stakeholders about the impact of regional participation when compared to national participation. It is possible that regional participation affords students with resources and positive experiences near the local area where they may intend to pursue their future career and produce stronger outcomes as a result. Understanding these potential impacts may help faculty advisors to know where to invest resources for student development activities.

FIT-Choice Scale

While the ability-expectancy beliefs and utility beliefs perceived by students showed no statistically significant impact on the relationship between participation in TEECA and their intent to teach, further analysis may help to identify how other interventions may influence these belief items leading to an impact on students' intentions for their future. With the modified belief constructs, additional studies may identify how these beliefs contribute to a students' future intentions with respect to

pursuing a teaching career. While these items were identified from the FIT-Choice Scale, the exploratory factor analysis identified some variance from the original scale items as used in previous studies. As studies within the field of TEE have not been conducted using the FIT-Choice Scale, studies investigating teacher recruitment and retention within the field of TEE using an adapted FIT-Choice Scale could prove useful for understanding what factors influence TEE teachers in pursuing and remaining in the field of education.

Additionally, an adapted FIT-Choice model, the Ag Ed FIT-Choice Scale was developed for agricultural education post-secondary students to investigate their choice to teach (Lawver & Torres, 2012). Using the framework and process of development for the Ag Ed FIT-Choice Scale, a survey designed for TEE students could be developed and disseminated to understand the motivations of teaching track students.

Additionally, as the utility beliefs identified in this study showed a statistically significant correlation with students' future interests and intentions, future research regarding the impact of utility beliefs on the recruitment and retention of Technology and Engineering educators would be beneficial in informing how to sustain the TEE field. Using the items identified in the utility belief factor, a study observing the beliefs of in-service teachers at different stages of their career could identify how utility beliefs impact the likelihood of teacher attrition.

TEECA Program Structure

Most respondents were students who intended to pursue education as a career. As this study recruited students through program faculty, future studies looking at the impact of TEECA may need to identify how to extend research to non-teaching students in the programs with both teaching and industry track options. Additionally, it is unclear how many TEECA chapters recruit students from outside of the undergraduate TEE program. This information may provide an area to assess the impact of TEECA in influencing students to pursue careers in technology and engineering education.

Future research surrounding TEECA may require further clarification of how individual TEECA chapters function within various universities. One participant mentioned that TEECA chapter meeting attendance was part of their studies indicating that it is required to graduate from their program. Another student explained a project their TEECA chapter is working on for their university's library as part of their chapter's community outreach. While outreach is not a requirement for TEECA chapters, increased understanding of the structure of chapter practices may help TEECA contribute to the development of current and future TEE students and how outreach may impact recruitment practices through increased TEE program visibility.

Another suggestion for future research would be to alter the survey tool by asking students to include the name of their major to inform the research on their program and

licensure intentions. While the questionnaire asked participants if they were interested in teaching, it was unclear if the student was enrolled in a teaching track.

Furthering Interviews

With only one researcher conducting and coding the interviews, no interrater reliability could be found. The number of interviews was also limited by the number of participants that responded to scheduling an interview. The current interviews could be coded by additional researchers. Following the additional coding, the findings could be triangulated, and an interrater reliability could be found.

Additionally, this research could be expanded to additional TEE students. While the interviews aimed to identify the impact of TEECA on the retention within the undergraduate program and the student's intent to pursue teaching, themes began to arise surrounding why the participants chose to pursue education as a career. Additional coding and conducting of interviews of TEE students could help inform future recruitment for TEE programs.

Recruiting Aspiring Teachers

A common trend among the interview participants was that students had interest in pursuing education as a career prior to enrolling in their TEE undergraduate program.

The desire to become an educator for some superseded the content that they intended to teach. Multiple participants indicated that they were planning to teach and took a leap by pursuing teaching technology and engineering as a career. Despite one interview participant indicating that they transferred from an engineering major to pursue TEE, it may be more effective to recruit from other education majors. The success of specific recruitment efforts may depend on whether the program has an industry option or if it is solely a teacher-licensure program. Some program faculty have tried recruiting for their TEE programs out of other majors related to technology and engineering. However, the field of TEE is struggling with attrition with teachers exiting education to pursue a career in industry (Schmitt & deCourcy, 2022). In addition to recruiting out of technology and engineering industry preparation majors, TEE programs could benefit from recruiting students that are already intending to pursue teaching as a future career (i.e., Math education, History education). By focusing on those already intending to become an educator there may be a reduction in attrition in new TEE teachers.

Program Visibility and Recruitment

Multiple students indicated that they did not know that TEE was a degree. Despite having taken technology courses in high school, this may indicate that teachers are not recommending teaching technology and engineering as a future career. With previous studies (e.g., Love & Love, 2022) indicating that high school teachers have an influence

on those that choose to pursue teaching technology and engineering as a career, further efforts could be made to encourage teachers to recruit future teachers.

Additionally, one participant noted that once he decided to pursue TEE as a career, he struggled to identify a program to attend. This may be in part due to programs each having different titles or structures, but it could also suggest that programs may need to improve online visibility and marketing. Online visibility may be reliant on the university website. However, with some programs being industry-focused programs, students may not know that an education emphasis is an option.

Future studies gathering information on the status of programs listed in the NCES database as well as the programs listed by Love and Maiseroulle (2021) would assist in establishing the status of TEE across the nation. Additionally, gathering data on the supply and demand for TEE teachers would inform on the shortages that are present today. The National Association of Agricultural Educators (NAAE, 2024) has aggregated data on the supply and demand of agricultural educators since 1999. The TEE field would benefit from a similar long-term effort toward understanding where the needs are or are not being met across the nation.

Program Content

In addition to unfilled positions, understanding the content that needs to be taught would also inform technology and engineering teacher preparation programs whether the content they are training their pre-service teachers is appropriate. This would require data collection regarding the programs being taught in secondary schools and whether TEE graduates in the state are certified to teach those courses.

Additionally, understanding the transferability of skills and knowledge would help to see how aligned TEE programs across the nation are. The processes of transferring teacher licensure from state to state differs in each state. However, it is unknown how transferable the content or knowledge learned in one university's program is transferable between university programs as well as between states.

Summary

This chapter addressed the research questions guiding this investigation and made conclusions according to the accompanying hypotheses. In addition to the conclusions, this section discussed findings and provided suggestions for practice and future studies.

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APPENDIX A.

AGRICULTURE EDUCATION VALIDATION SURVEY

Impact of pre-professional organization on Ag Ed majors

Start of Block: Informed Consent

Q1 Please read the following

Informed consent document

Q2 I agree to participate in this survey

- Yes (1)
- No (2)

End of Block: Informed Consent

Start of Block: Block 2

Q10 Including this year, what year of college are you currently completing?

▼ 1st (1) ... 10th+ (10)

Q16 Including this year, what year as an enrolled Agriculture Education major are you currently in?

▼ 1st (1) ... 10th + (10)

Q11 How do you describe yourself?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer to self-describe (4)

_____

- ○ Prefer not to say (5)

End of Block: Block 2

Start of Block: Block 1

Q4 Please answer the following questions

0 1 2 3 4 5 6 7 8 9 10

Including this year, how many years have you been a member of USU Collegiate FFA/Ag Ed Club? ()	

Q17 As a college student, how many FFA state, regional, and/or national conferences, competitions, or events have you participated in (include events where you served as a judge)?

_____

Q5 About how often do you attend Collegiate FFA/Agriculture Education club chapter meetings?

- ○ Never (1)
- ○ Once per semester (2)
- ○ Monthly (3)
- ○ Weekly (4)

Q6 We would like to know about your perception related to the teaching profession and your major. Please respond to the following prompts

	Not true at all (1)	Somewhat untrue (2)	Neutral (3)	Somewhat true (4)	Very true (5)
I have the skills and characteristics to succeed as a teacher (1)	○	○	○	○	○
Teachers are influential in society (2)	○	○	○	○	○
Teachers shape adolescents' values (3)	○	○	○	○	○
Teachers are influential on student's college or career choices (4)	○	○	○	○	○

Teachers make a worthwhile social contribution (5)	○	○	○	○	○
I am interested in teaching (6)	○	○	○	○	○
I like teaching (7)	○	○	○	○	○
I am interested in the content in my major (8)	○	○	○	○	○
I plan on graduating from this major (9)	○	○	○	○	○
I chose my major as a last resort (10)	○	○	○	○	○

Q7 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	Very bad (1)	Somewhat bad (2)	Average (3)	Somewhat good (4)	Very good (5)
How would you rate your teaching abilities? (1)	○	○	○	○	○
How would you rate your ability to learn something new in your content area? (2)	○	○	○	○	○
How well do you expect to do in your major courses this year? (3)	○	○	○	○	○

How would you rate your ability to teach within your content area? (4)	○	○	○	○	○

Q8 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	One of the worst (1)	Below average (2)	Average (3)	Above average (4)	One of the best (5)
If you were to list all the students in your program from worst to the best at teaching, how would you rank yourself? (1)	○	○	○	○	○

Q9 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	A lot worse in my content courses than other subjects (1)	Somewhat worse in my content courses than other subjects (2)	About the same in my content courses than other subjects (3)	Somewhat better in my content courses than other subjects (4)	A lot better in my content courses than in other subjects (5)
Compared to other subjects outside of your major (general education) how did you perform in your major content courses? (1)	○	○	○	○	○

Q18 Did you find any of the above items confusing or unclear? If yes, please list those items and what you found to be unclear in the space below.

_____

_____

_____

_____

_____

End of Block: Block 1

APPENDIX B.

TECHNOLOGY AND ENGINEERING EDUCATION SURVEY

Impact of TEECA on TEE majors

Start of Block: Informed Consent

Q1 Please read the following

Informed consent document

Q2 I agree to participate in this survey

- Yes (1)
- No (2)

End of Block: Informed Consent

Start of Block: Block 2

Q10 Including this year, what year in college are you currently completing??

▼ 1st (1) ... 10th+ (10)

Q16 Including this year, what year as an enrolled as a Technology and Engineering Education major are you currently completing?

▼ 1st (1) ... 10th+ (10)

Q11 How do you describe yourself?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer to self-describe (4)

_____

- ○ Prefer not to say (5)

Q15 Choose one or more races that you consider yourself to be

- ☐ White or Caucasian (1)
- ☐ Black or African American (2)
- ☐ American Indian/Native American or Alaska Native (3)
- ☐ Asian (4)

- [ ] Native Hawaiian or Other Pacific Islander (5)
- [ ] Other (6)
- [ ] Prefer not to say (7)

End of Block: Block 2

Start of Block: Block 1

Q4 Please answer the following questions

0 1 2 3 4 5 6 7 8 9 10

Including this year, how many years have you registered as a member of Technology and Engineering Educators Collegiate Association (TEECA)? ()	
Including this year, how many state, regional, and/or national conferences have you attended? ()	

Q17 How many TEECA events/competitions have you participated in (This includes state, regional, and national competitions. Multiple competitions in the same year count for each competition)?

_____

Q5 About how often do you attend TEECA chapter meetings?

- ○ Never (1)
- ○ Once per semester (2)
- ○ Monthly (3)
- ○ Weekly (4)

Q6 We would like to know about your perception related to the teaching profession and your major. Please respond to the following prompts

	Not true at all (1)	Somewhat untrue (2)	Neutral (3)	Somewhat true (4)	Very true (5)
I have the skills and characteristics to succeed as a teacher (1)	○	○	○	○	○
Teachers are influential in society (2)	○	○	○	○	○
Teachers shape adolescents' values (3)	○	○	○	○	○
Teachers are influential on student's college or career choices (4)	○	○	○	○	○

Teachers make a worthwhile social contribution (5)	○	○	○	○	○
I am interested in teaching (6)	○	○	○	○	○
I like teaching (7)	○	○	○	○	○
I chose teaching as a last-resort career (8)	○	○	○	○	○
I am interested in the content in my major (9)	○	○	○	○	○

I plan on graduating from this major (10)	○	○	○	○	○
I chose my major as a last resort (11)	○	○	○	○	○

Q7 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	Very bad (1)	Somewhat bad (2)	Average (3)	Somewhat good (4)	Very good (5)
How would you rate your teaching abilities? (1)	○	○	○	○	○
How would you rate your ability to learn something new in your content area? (2)	○	○	○	○	○

How well do you expect to do in your major courses this year? (3)	○	○	○	○	○
How would you rate your ability to teach within your content area? (4)	○	○	○	○	○

Q8 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	One of the worst (1)	Below average (2)	Average (3)	Above average (4)	One of the best (5)
If you were to list all the students in your program from worst to the best at teaching, how would you rank yourself? (1)	○	○	○	○	○

Q9 We would like to know about your perception of your own abilities in teaching and in your major. Please respond to the following prompts

	A lot worse in my content courses than other subjects (1)	Somewhat worse in my content courses than other subjects (2)	About the same in my content courses than other subjects (3)	Somewhat better in my content courses than other subjects (4)	A lot better in my content courses than in other subjects (5)
Compared to other subjects outside of your major (general education) how did you perform in your major content courses? (1)	○	○	○	○	○

End of Block: Block 1

APPENDIX C.

INTERVIEW PROTOCOL

General Procedures

1. Set up zoom conference adhering to the participant's schedule through their preferred contact method of choice.
2. Invite the participants to participate in the interview via Zoom or phone.
3. After participants join the zoom or phone meeting, seek permission to record the interview.
4. Verify the interview is being recorded
5. Ask one question at a time
6. Attempt to remain as neutral as possible
7. Encourage responses
8. Provide transition between major topics
9. Do not lose control of the interview
10. Use sound listening techniques
11. Follow the respondent. Follow up on new information they bring up without losing a sense of where you are in the interview.
12. Follow post-interview procedures.

Interview Script

Hello, my name is Emily Ruesch, and I would like to thank you for agreeing to participate in this interview investigating the impact of TEECA on undergraduate TEE students' interest in teaching, I would like to record this meeting. "Do I have your permission to record this interview?"

Again, I would like to thank you for participating in this interview. Throughout this study, I will take steps to protect your identity by using a pseudonym instead of your legal name. I will not mention anything identifiable in anything that is published. I will modify identifying factors that you choose to share with me. Your responses in part or in full, can, however, be published in this research.

Please know that any time you feel uncomfortable during this interview and do not want to answer specific questions, that is fine. We can choose to skip the question or terminate the interview. If at any time you do not want to continue this interview, please let me know, and we will stop the interview. Do you understand?

Interview Questions

1. How would you describe your TEECA participation.
2. For those that have expressed a level of participation with TEECA
    1. How would you explain your experience with participating in TEECA?

2. How would you describe how TEECA has shaped your decisions regarding your intentions for a future career or job within or out of education?

3. How would you explain your experience within your technology and engineering education teacher preparation program?

Closure

This concludes our interview. Do you have any questions? I would like to thank you again for your participation. Please feel free to follow up with me at any time regarding this interview and study results. Here is my contact information.

Post Interview Procedures

1. Save the video or audio file in a password protected Box.com folder.
2. Make digitize any written notes.
3. Record any observations made during the interview.

APPENDIX D.

IRB CERTIFICATE OF EXEMPTION AND INFORMED CONSENT DOCUMENTS

Research
UtahStateUniversity

Certificate of Exemption

From: Melanie Domenech Rodríguez, Ph.D.
Chair, Institutional Review Board

Nicole Vouvalis, J.D.
Director of Human Research Protections

To: Joseph Furse
Date: 2023-04-06
Protocol #: 13388
Title: Investigating the impact of participation in pre-professional organizations on pre-service TEE teachers

Your proposal has been reviewed by the Institutional Review Board and is approved under Exempt procedure(s) Exemption 2 (based on the Department of Health and Human Services (DHHS) regulations for the protection of human research subjects, 45 CFR Part 46, as amended to include provisions of the Federal Policy for the Protection of Human Subjects, January 21, 2019):

> Research that only includes interactions involving educational tests, survey procedures, interview procedures, or observation (including recording) of public behavior if the identity of the human subjects cannot readily be ascertained.; Research that only includes interactions involving educational tests, survey procedures, interview procedures, or observation (including recording) if the identity of the human subjects can readily be ascertained and the IRB conducts a limited IRB review.; Research that only includes educational tests, survey procedures, interview procedures, or observation (including recording) if disclosure of the data outside the research would not reasonably place the subjects at risk of liability or damage.

This approval applies only to the proposal currently on file for the period of approval specified in the protocol. The expiration date matches your project completion date set in the Procedures section of your protocol. It is eligible for up to five years of exemption, at which point, it will be closed and a new exemption will need to be requested.

Any change affecting human subjects, including extension of the expiration date, must be approved by the IRB **prior** to implementation by submitting an Amendment request. Injuries or any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Institutional Review Board. If Non-USU Personnel will complete work on this project, they may not begin until an External Researcher Agreement or Reliance Agreement has been fully executed by USU and the appropriate Non-USU entity, regardless of the protocol approval status here at USU.

Prior to involving human subjects, properly executed informed consent must be obtained from each subject or from an authorized representative, and documentation of informed consent must be kept on file for at least three years after the project ends. Each subject must be furnished with a copy of the informed consent document for their personal records.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to irb@usu.edu. The IRB wishes you success with your research.

Research
UtahStateUniversity

Protocol #13388
IRB Exemption Date: April 6, 2023
Consent Document Expires: August 31, 2023

v.2.2

Letter of Information

Investigating the Impact of Participation in Pre-professional Organizations on Pre-service TEE Teachers

You are invited to participate in a research study by Joseph Furse and Emily Yoshikawa-Ruesch a faculty member and graduate student in the Department of Applied Sciences, Technology, and Education at Utah State University

The purpose of this research is to learn about the impacts of participation in a pre-professional organization on pre-service technology and engineering education (TEE) teachers.

For this phase of research, we are wanting to do a pilot study with agriculture education students at Utah State University to help validate the survey. This process will help inform us if the survey is easily understood by participants. You are being asked to participate in this research because you are a current agriculture education undergraduate student at Utah State University.

Your participation in this study is voluntary and you may withdraw your participation at any time and for any reason by electing not to continue answering survey questions, and/or by notifying the research team.

If you take part in this study, you will be asked to answer questions in an online survey regarding whether or not you have participated in a pre-professional organization, and to which extent, as well as your value and intentions to continue in agricultural education. which will take approximately 5-10 minutes to complete.

The possible risks of participating in this study include minimal risk of loss of confidentiality. We cannot guarantee that you will directly benefit from this study as it has been designed to learn more about the impact of participation on TEE students and pre-service teachers.

We will make every effort to ensure that the information you provide remains confidential. We will not reveal your identity in any publications, presentations, or reports resulting from this research study.

We will collect your information through an online survey conducted via Qualtrics. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This survey data will be securely stored in Qualtrics and/or a restricted-access folder on Box.com, both accessible only by password and two-factor authentication.

You can decline to participate in any part of this study for any reason and can end your participation at any time.

If you have any questions about this study, you can contact Joseph Furse (joseph.furse@usu.edu, 435-797-1802) or Emily Yoshikawa-Ruesch (emily.ruesch@usu.edu). If you have any concerns about this study, please contact Utah State University's Human Research Protection Office at (435) 797-0567 or irb@usu.edu. Thank you again for your time and consideration.

By continuing to the survey you agree that you are 18 years of age or older, and wish to participate. You agree that you understand the risks and benefits of participation and that you know what you are being asked to do. You also agree that you have contacted the research team with any questions about your participation, and are clear on how to stop your participation in this study if you choose to do so. Please be sure to retain a copy of this form for your records.

Research
UtahStateUniversity

Protocol #13388
IRB Exemption Date: April 6, 2023
Consent Document Expires: October 31, 2023

v.2.2

Letter of Information

Investigating the impact of participation in pre-professional organizations on TEE majors and TEE pre-service teachers

You are invited to participate in a research study by Joseph Furse and Emily Yoshikawa-Ruesch a faculty member and graduate student in the Department of Applied Sciences, Technology, and Education at Utah State University

The purpose of this research is to learn about the impacts of participation in the pre-professional organization, Technology and Engineering Educators Collegiate Association (TEECA), on technology and engineering education (TEE) undergraduate students. As program names may differ by university, this can include Technology Management, STEM education, Technology and Engineering Studies, Engineering and Technology Teacher Education, etc. Despite the name of the program, we are looking that your program is affiliated with TEECA. Specifically, we are interested in learning about what influence TEECA has on the value placed on the TEE profession and the pre-service teacher's intention to continue in the undergraduate program and pursue different careers. You are being asked to participate in this research because you are currently enrolled in an undergraduate program affiliated with TEECA.

Your participation in this study is voluntary and you may withdraw your participation at any time and for any reason by electing not to continue answering survey questions, and/or by notifying the research team.

If you take part in this study, you will be asked to answer questions in an online survey regarding whether or not you have participated in TEECA, and your future career intentions. This survey will take approximately 5-10 minutes to complete.

Following the survey, you will have the option to provide contact information if you are willing to participate in future interviews that may take place regarding your participation in TEECA and your intention to continue in your major and become a teacher. This information will not be linked to the survey responses you provide and will only be kept until the close of data collection in August 2023. During the data collection phase, any personal information will be kept in a dual-factor password-protected Box folder.

The possible risks of participating in this study include minimal risk of loss of confidentiality. We cannot guarantee that you will directly benefit from this study, but it has been designed to learn more about the impact of participation in TEECA on TEE students and pre-service teachers.

We will make every effort to ensure that the information you provide remains confidential. We will not reveal your identity in any publications, presentations, or reports resulting from this research study.

We will collect your information through an online survey conducted via Qualtrics. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This survey data will be securely stored in Qualtrics and/or a restricted-access folder on Box.com, both accessible only by password and two-factor authentication. You can decline to participate in any part of this study for any reason and can end your participation at any time by closing your web browser.

If you have any questions about this study, you can contact Joseph Furse (joseph.furse@usu.edu, 435-797-1802) or Emily Yoshikawa-Ruesch (emily.ruesch@usu.edu). If you have any concerns about this study, please contact Utah State University's Human Research Protection Office at (435) 797-0567 or irb@usu.edu. Thank you again for your time and consideration.

By continuing to the survey you agree that you are 18 years of age or older, and wish to participate. You agree that you understand the risks and benefits of participation and that you know what you are being asked to do. You also agree that you have contacted the research team with any questions about your participation, and are clear on how to stop your participation in this study if you choose to do so. Please be sure to retain a copy of this form for your records.

Research
UtahStateUniversity

Protocol #13388
IRB Exemption Date: April 6, 2023
Consent Document Expires: August 31, 2023

v.2.2

Informed Consent

Investigating the impact of participation in pre-professional organizations on pre-service TEE teachers

You are invited to participate in a research study by Joseph Furse and Emily Yoshikawa-Ruesch a faculty member and graduate student in the Department of Applied Sciences, Technology, and Education at Utah State University

The purpose of this research is to learn about the impacts of participation in the pre-professional organization, Technology and Engineering Educators Collegiate Association (TEECA), on pre-service technology and engineering education (TEE) teachers. Specifically, we are interested in learning about what influence TEECA has on the value placed on the TEE profession and the pre-service teacher's intention to continue in the TEE teacher preparation program and become a technology and engineering educator. You are being asked to participate in this research because you are currently enrolled in an undergraduate TEE teacher preparation program.

Your participation in this study is voluntary, and you may withdraw your participation at any time and for any reason by electing not to continue answering interview questions and/or by notifying the research team.

If you participate in this interview, you will be asked to answer questions in a recorded online video interview which will take approximately 15 minutes to complete, but we will be scheduling interviews for 30-minute time slots. The questions that will be asked in the interview are to learn more about your experiences and perspectives.

The possible risks of participating in this study include minimal risk of loss of confidentiality. We cannot guarantee that you will directly benefit from this study, but it has been designed to learn more about the impact of participation in TEECA on TEE students and pre-service teachers.

We will make every effort to ensure that the information you provide remains confidential. We will not reveal your identity in any publications, presentations, or reports resulting from this research study.

We will collect your information through a recorded online video conference. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. These recordings will be destroyed at the conclusion of the study. This informed consent data will be securely stored in Qualtrics and/or a restricted-access folder on Box.com, both accessible only by password and two-factor authentication. Any recordings collected during the interview phase of this study will be kept in a two-factor password-protected Box folder. Following the recording of all interviews, we will be transcribing and de-identifying all recordings. All recordings will be destroyed following this transcription phase. None of the interview transcriptions will contain personal information linking to the participants.

If you have any questions about this study, you can contact Joseph Furse (joseph.furse@usu.edu, 435-797-1802) or Emily Yoshikawa-Ruesch (emily.ruesch@usu.edu). If you have any concerns about this study, please contact Utah State University's Human Research Protection Office at (435) 797-0567 or irb@usu.edu. Thank you again for your time and consideration.

By signing below, you agree to participate in this study. You indicate that you understand the risks and benefits of participation, and that you know what you will be asked to do. You also agree that you have asked any questions you might have, and are clear on how to stop your participation in the study if you choose to do so. Please be sure to retain a copy of this form for your records.

Participant's Signature	Participant's Name, Printed	Date

CURRICULUM VITAE

Emily Yoshikawa-Ruesch

Current Position

Lecturer – Technology and Engineering Education
Department of Applied Sciences, Technology & Education
College of Agriculture & Applied Sciences
Utah State University
Logan, Utah

Education

2021- Present **Doctor of Philosophy**
Utah State University
Logan, Utah
Major: Career and Technical Education
Emphasis: Technology and Engineering Education
Co-Advisors: Joseph Furse and Debra Spielmaker
Dissertation: Investigating the impact of pre-professional organization participation on undergraduate technology and engineering education student retention and interest in teaching

2018 **Master of Science**
Purdue University
West Lafayette, IN
Major: Technology, Leadership, and Innovation
Emphasis: Engineering and Technology Teacher Education
Advisor: Scott Bartholomew
Thesis: The impacts of providing and receiving formative peer feedback on secondary students' achievement on a graphic design project

2016 **Bachelor of Science**
Brigham Young University

Provo, UT
Major: Technology and Engineering Education
Emphases: Engineering and Multimedia

Certifications

Utah Professional Teaching License with Multimedia Endorsement
PLTW Introduction to Engineering
PLTW Digital Electronics

Teaching Experience

2023 - Present **Lecturer**
Department of Applied Sciences, Technology & Education
College of Agriculture & Applied Sciences
Utah State University
Logan, Utah

Courses Taught

Fall 2023
ASTE/TEE 3440: Science, Technology and Modern Society
TEE 4300: Clinical Experience II
TEE 2000: Seminar in Leadership

2021 - 2023 **Graduate Teaching Assistant**
Department of Applied Sciences, Technology & Education
College of Agriculture & Applied Sciences
Utah State University
Logan, Utah

Courses Taught

Spring 2024
TEE 2000: Seminar in Leadership and Professional Development
ASTE/TEE 3440: Science, Technology and Modern Society (Face-to-face and online)
TEE 3300: Clinical Experience II

	Fall 2023	TEE 2000: Seminar in Leadership and Professional Development ASTE/TEE 3440: Science, Technology and Modern Society (Face-to-face and online) TEE 4300: Clinical Experience II
	Spring 2023	TEE 3300: Clinical Experience I ASTE 6460: CTE in STEM
	Fall 2022	Student Teaching Evaluator TEE 4300: Clinical Experience II TEE 1030: Material Processing Systems
	Summer 2022	ASTE 6910 • Experimental Laboratory
	Spring 2022	TEE 1030: Material Processing Systems
	Fall 2021	TEE 1030: Material Processing Systems

2020-2021 **Technology and Engineering Educator**
Northridge High School
Davis School District
Layton, UT

Courses Taught
Robotics 1
Robotics 2
Exploring Computer Science

2018-2020 **Technology and Engineering Educator**
Weber Innovation High School
Weber School District
Ogden, UT

Courses Taught
Physics with Technology
PLTW Introduction to Engineering Design

PLTW Digital Electronics
Engineering Design and Development (Senior Capstone Course)

Additional Responsibilities
I was the Professional Learning Community Team Lead for both Physics with Technology and Introduction to Engineering Design for 2019-2020. I also served as a Technology Student Association (TSA) advisor from 2018-2020.

2016 **Student Teacher**
Mountain Ridge Jr. High
Alpine School District
Highland Utah

Courses Taught
College and Career Awareness
Multimedia Design

2016 **Student Teacher**
Advanced Learning Center
Nebo School District
Springville, UT

Courses Taught
PLTW Introduction to Engineering Design
Principles of Engineering
Robotics
Engineering Design and Development (Senior Capstone Course)

2015 **Teaching Assistant**
Brigham Young University
Provo, UT

Course Taught
TEE 340: Principles of Technology and Engineering

Related Experience

2021- 2023 **Graduate Research Assistant**
Utah State University
Logan, Utah

- Studying the role of Technology and Engineering Education Collegiate Association in the persistence of students enrolled in Technology and Engineering teacher preparation programs.
- Studying the role of mentoring in the retention of new technology and engineering teachers.
- Developed Curriculum for 7th grade College and Career Awareness using composites to help encourage females into the aerospace industry.

2017-2018 **Graduate Research Assistant**
Purdue University
West Lafayette, IN

- Studied the implementation of Adaptive Comparative Judgment (ACJ) in school systems to improve assessment. Studied student improvement in design thinking using peer evaluation using ACJ.
- Developed curricula for kindergarten children to experience engineering activities using nursery rhymes.

2014-2016 **Undergraduate Research Assistant**
Brigham Young University
Provo, UT

- Studied teacher self-efficacy through the implementation of engineering concepts in elementary schools.
- Studied computational thinking through coding of different aged elementary students.

Publications (refereed)

2023 Furse, J.S., **Yoshikawa-Ruesch, E.** (2023). The development and implementation of standards-based technology and engineering curricula in secondary

education. In S. Bartholomew, M. Hoepfl, J.Williams (Eds.), *Standards-based Program Planning and Implementation in Technology and Engineering Education.*

Yoshikawa-Ruesch, E., & Furse, J.S. (2023). Influence of Pre-professional Organizations on TEE Students. In S. Davies, M. McLain, A. Hardy & D. Morrison-Love (Eds) (2023), *The 40th International Pupils' Attitudes Towards Technology Conference Proceedings 2023, 31 October – 3 November, Liverpool John Moores University, Liverpool, UK,* 862-872.

Furse, J.S., Ortiz, C., **Yoshikawa-Ruesch, E**., & Lloyd, H. (2023). Mentoring on Early-Career Technology and Engineering Teachers. In S. Davies, M. McLain, A. Hardy & D. Morrison-Love (Eds) (2023), *The 40th International Pupils' Attitudes Towards Technology Conference Proceedings 2023, 31 October – 3 November, Liverpool John Moores University, Liverpool, UK,* 305-317.

2021 Strimel, G. J., Bartholomew, S. R., Purzer, S., & **Yoshikawa, E**. (2021). Informing engineering design through adaptive comparative judgment. *European Journal of Engineering Education, 46*(2), 227-246.

2020 Bartholomew, S. R., **Yoshikawa, E.**, Hartell, E., & Strimel, G. J. (2020). Identifying design values across countries through adaptive comparative judgment. *International Journal of Technology and Design Education, 30(2)*, 321-347. https://doi.org/10.1007/s10798-019-09506-8

2019 Bartholomew, S. R., Moon, C., **Yoshikawa, E**., & Strimel, G. J. (2019). Kindergarten student's approaches to resolving open-ended design tasks. *Journal of Technology Education, 30*(2), 90-115.

2018 Lecorchick III, D., Maynard, J., Morin, M., Nichols, S., Peterson, B., & **Ruesch, E.Y.** (2018) School-based mentoring: High school students mentor elementary students. *The Elementary STEM Journal, 23*(1), 18-21.

Bartholomew, S. R., Strimel, G.S., **Yoshikawa, E.** (2018). Using adaptive comparative judgment for student formative feedback and learning during a middle school open-ended design challenge. *International Journal of Technology & Design Education 29*(2), 363-385.

Swift, C., Strimel, G. J., Bartholomew, S. R. & **Yoshikawa, E.** (2018). Cultivating a family of innovators through design thinking. *Children's Technology and Engineering, 22*(4), 7-11.

Bartholomew, S. R., & **Ruesch, E. Y.** (2018). Design fixation and divergent thinking in primary children. *Technology and Engineering Teacher*, *78*(2), 26-31.

Bartholomew, S. R., **Yoshikawa, E.**, & Strimel, G. J. (2018). Perceptions and reality: Analyzing student experiences in ranking self and peer work through adaptive comparative judgment. In N. Seery, D. Canty, J Buckley, & J. Phelan (Eds) (2018), *The 35th International Pupils' Attitudes Towards Technology Conference Proceedings 2018, 18-21 June, Technological University of the Shannon, Athlone, Ireland,* 513-520.

Bartholomew, S. R., **Yoshikawa, E.**, & Connolly, P. (2018). Exploring the Potential for Identifying Student Competencies in Design Education through Adaptive Comparative Judgment. In N. Seery, D. Canty, J Buckley, & J. Phelan (Eds) (2018), *The 35th International Pupils' Attitudes Towards Technology Conference Proceedings 2018, 18-21 June, Technological University of the Shannon, Athlone, Ireland,* 513-520.

Bartholomew, S. R., **Yoshikawa, E**., Hartell, E. & Strimel, G. J. (2018). Design values, preferences, similarities, and differences across three countries. In N. Seery, D. Canty, J Buckley, & J. Phelan (Eds) (2018), *The 35th International Pupils' Attitudes Towards Technology Conference Proceedings 2018, 18-21 June, Technological University of the Shannon, Athlone, Ireland,* 432-440.

Rich, P. J., Belikov, O., **Yoshikawa, E.**, Perkins, M., (2018). Enablers and inhibitors to integrating computing and engineering lessons in elementary education. *Journal of Technology and Teacher Education, 26*(3).

Bartholomew, S. R., **Yoshikawa, E.** (2018). A systematic review of research around adaptive comparative judgment (ACJ) in K-16 education. *2018 Council on Technology and Engineering Teacher Education: Research Monograph Series.* https://doi.org/10.21061/ctete-rms.v1.c.1

2017 **Yoshikawa, E.,** Strimel, G. S., Bartholomew, S. R. (2017). Designing the technological world through biomimicry. *Children's Technology and Engineering, 22(1),* 18-22.

Yoshikawa, E., Ayres, D., Guzey, S. (2017). Integrated STEM in middle school: A Purdue service-learning class. *Purdue Journal of Service-Learning and*

International Engagement, 1(4).

Rich, P J., Jones, B. L., Belikov, O., **Yoshikawa, E.**, Perkins, M. (2017). Computing and engineering in elementary school: The effect of year long training on elementary teacher self-efficacy and beliefs about teaching computing and engineering. *International Journal of Computer Science Education, 1*(1), 1-20.

Publications (non-refereed)

2022 Miller, A. J., Konakis, Z. A., **Yoshikawa-Ruesch, E.**, Spielmaker, D. M., & Stewardson, D. (2022). Evaluating the Utah Agriculture in the Classroom pre-service teacher seminar. *Outcomes and Impact Quarterly, 2*(4). https://doi.org/https://doi.org/10.26077/b9b9-39a8

2019 **Yoshikawa, E.** & Bartholomew, S. R. (2019). STEM children's rhymes: It's raining, it's pouring. *The Elementary STEM Journal, 23*(4), 24-27.

Yoshikawa, E. & Bartholomew, S. R. (2019). STEM children's rhymes: London bridge. *The Elementary STEM Journal, 23*(3), 20-25.

Yoshikawa, E. & Bartholomew, S. R. (2019). STEM children's rhymes: Little Boy Blue. *The Elementary STEM Journal, 23*(2), 22-25.

Yoshikawa, E. & Bartholomew, S. R. (2019). STEM children's rhymes: Little Bo Peep. *The Elementary STEM Journal, 23*(1), 24-27.

2018 Lecorchick III, D., Maynard, J., Morin, M., Nichols, S., Peterson, B., & **Ruesch, E.**, (2018). School-based mentoring: High school students mentor elementary students. *The Elementary STEM Journal, 23*(1), 18-23.

Yoshikawa, E. & Bartholomew, S. R. (2018). STEM children's rhymes: Jack and Jill. *Children's Technology and Engineering, 22*(4), 26-28.

Yoshikawa, E. & Bartholomew, S. R. (2018). Resources in technology education: Golf. *The Technology & Engineering Education Teacher, 77*(6), 32-35.

Yoshikawa, E. & Bartholomew, S. R. (2018). STEM children's rhymes: Baa baa black sheep. *Children's Technology and Engineering, 22*(3), 22-25.

2017 **Yoshikawa, E.** & Bartholomew, S. R. (2017). STEM children's rhymes: Humpty

Dumpty. *Children's Technology and Engineering, 22*(2), 20-23.

Yoshikawa, E. & Bartholomew, S. R. (2017). STEM children's rhymes: Itsy bitsy spider. *Children's Technology and Engineering, 22*(1), 25-29.

Yoshikawa, E. & Bartholomew, S. R. (2017). Taking PBL to the next level. *ACTE: Techniques, May 2017, 92*(5), 48-51.

Conference Presentations and Posters

2023

Furse, J.S., Ortiz, C., **Yoshikawa-Ruesch, E.**, Lloyd, H. (2023, April 12-15). *Impacts of early career mentoring on TEE teachers* [Conference session]. *International Technology and Engineering Education Association*. Minneapolis, MN.

Yoshikawa-Ruesch, E., Ware, S., (2023, February 3-4). *What I wish I would have known year one* [Conference session]. Utah Association for Career and Technical Education. West Jordan, UT, United States.

2022

Miller, A.J., Konakis, Z.A., **Yoshikawa-Ruesch, E.**, Spielmaker, D. (2022, September 19-21). *Agriculture in the classroom pre-service teacher seminar evaluation* [Poster presentation]. Western Region American Association for Agricultural Education. Las Cruces, NM, United States.

Yoshikawa-Ruesch, E., Furse, J., & Spielmaker, D. (2022, February 4-5). *CCA: Composite materials in the medical industry PBL [Conference session]*. Utah Association for Career and Technical Education. St. George, UT, United States

2020

Lecorchick, D., Nichols, Scott., **Yoshikawa-Ruesch, E**., Peterson, B., & Maynard, J. (2020, March 11-14). *Evolution of the Engineering Design Process - Part III* [Conference session] International Technology and Engineering Education Association. Baltimore, MD, United States.

2019

Peterson, B., **Yoshikawa-Ruesch, E**., Maynard, J., Lecorchick, D., & Morin, M. (2019, March 27-30). *Evolution of the Engineering Design Process - Part II* [Conference session]. International Technology and Engineering Education Association. Kansas City, KS, United States

Hartell, E., Strimel, G., Bartholomew, S., **Yoshikawa-Ruesch, E.** (2019, August 12-16). *Unpacking teachers' assessment practices in STEM education*

across countries [Conference session]. EARLI Conference for Research on Learning and Instruction.: Symposium. Aachen, North Rhine-Westphalia, Germany.

2018 Hartell, E., Strimel, G. J., Bartholomew, S. R., & **Yoshikawa, E**. (2018, September 9-14). *Adaptive comparative judgment in open-ended design scenarios* [Conference session]. International Association for Educational Assessment Conference, Oxford, United Kingdom.

Yoshikawa, E., Bartholomew, S.R., (2018, April 12-14). *Children's rhymes* [Poster session]. International Technology and Engineering Education Association. Atlanta, GA, United States.

Lecorchick, D., Peterson, B., Morin, M., **Yoshikawa-Ruesch, E.**, & Maynard, J. (2018, April 12-14) Evolution of the design process [Conference session]. International Technology and Engineering Education Association. Atlanta, GA, United States.

2016 Rich, P. J., **Yoshikawa, E.**, Belikov, O., Perkins, M., Browning, S., & Shoop, T. (2016, October 17-21). *Coding in K-8* [Conference session]. Association for Educational Communications and Technology. Las Vegas, NV, United States.

Rich, P. J., Jones, B., **Yoshikawa, E**., Belikov, O., & Perkins, M. (2016, October 17-21). *Supporting elementary teachers' integration of computing and engineering into their teaching* [Conference session]. Association for Educational Communications and Technology. Las Vegas, NV, United States.

2015 Rich, P. J., Jones, B. L., & **Yoshikawa, E**. (2015, November 4-7). *Teaching Elementary Teachers to Code and Engineer* [Conference session]. Association for Educational Communications and Technology. Indianapolis, IN, United States.

Honors and Awards

2023 Japanese American Citizens League Leadership Summit

2023 Maley Outstanding Graduate Student Citation

2021 Utah State University Presidential Doctoral Research Fellowship

2021	International Technology and Engineering Educators Association and Council on Technology and Engineering Teacher Education Outstanding Research Award
2020	International Technology and Engineering Educators Association Teacher Excellence Award
2020	Council on Technology and Engineering Teacher Education Co-Author of Outstanding Publication
2018	International Technology and Engineering Educators Association's 21st Century Leadership Academy 2018-2019 cohort
2016	Technology and Engineering Education Collegiate Association Student Leadership Award

Published Projects

2022 College and Career Awareness Team (2022, June 22) Tool-Up Tech: First Aid for the Backcountry. https://ccapbl.org/resources/tool-up-tech-first-aid-for-the-backcountry/

Curriculum development project sponsored by the UDMC grant looking to promote females in composites through College and Career Awareness curriculum.

Engagement

2017- 2018 **Advancing Excellence in P-12 Engineering Education Project**

Ongoing research venture to promote collaboration across the engineering and education community, to pursue a vision and direction for P-12 Engineering Education as well as develop a coherent and dynamic content framework for scaffolding the teaching and learning of engineering and design at the high school level.

Professional Service

2023-Present **TEECA Chapter Advisor**
Utah State University
Responsibilities include assisting and supporting students in competitive events and conference attendance.

2017- Present **Problem-Solving Competition Author**
Technology and Engineering Education Collegiate Association
Responsibilities include the development and implementation of the Problem-Solving competition for students from several universities participating in the Technology and Engineering Education Collegiate Association national competitions at the annual International Technology & Engineering Education Association conference.

2017- Present **Communications, Transportation, and Teaching Lesson Judge**
Technology and Engineering Education Collegiate Association
Responsibilities include supporting competition authors and providing constructive feedback for participants.

2018-2020 **Technology Student Association Advisor**
Weber Innovation High School
Responsibilities included supporting and facilitating students in the organization of student leadership and in their competitive events.

2017 **Vice President of the Purdue Latter-Day Saint Student Association**
Purdue University
Responsibilities included planning activities and assisting to build a culture of service for all association members.

2017-2018 **Graduate Advisor for Technology and Engineering Education Collegiate Association**
Purdue University
Responsibilities included supporting and mentoring undergraduate students in the Technology and Engineering Education Collegiate Association and helping guide them in participation in national competitive events.

2015-2016	**Peer Mentor for Women in Engineering** Brigham Young University Responsibilities included supporting other women in STEM and engineering to feel more integrated into the school and programs.
2012-2013	**Program Director for Y-Serve** Brigham Young University Responsibilities included tracking the budget for, recruiting volunteers, and planning service activities for Habitat for Humanity.

Professional Organizations

2020-Present	Japanese American Citizens League
2014-2016, 2020-Present	Utah Association for Career and Technical Education
2011-Present	International Technology and Engineering Education Student Association
2011-Present	Technology and Engineering Education Student Association