An Exploratory Study of Project Lead the Way Secondary Engineering Educators' Self-Efficacy

Brent D. Holt

Dissertation submitted to the Faculty
of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Curriculum and Instruction

Mark E. Sanders, Chair

Brenda R. Brand

John G. Wells

Tom O. Williams

October 24, 2011
Blacksburg, Virginia

Keywords: Teacher self-efficacy; PLTW; Engineering education; Teacher beliefs; Self-efficacy

An Exploratory Study of Project Lead the Way Secondary Engineering Educators' Self-Efficacy

Brent D. Holt

Abstract

Researchers find that teacher self-efficacy influences student performance and student academic interest (Anderson, Green & Loewen, 1988; Ross, 1992; Ashton & Webb, 1986; Woolfolk & Hoy, 1990; and Muijs & Reynolds, 2001) and that prior teaching and teacher preparation experiences influence teacher self-efficacy (Preito & Altmaier, 1994). Since the late 1990s, a significant number of teachers have been drafted to teach engineering content in secondary schools across America (NAE & NRC, 2009). Given that none of those teachers were specifically prepared for that task in pre-service secondary engineering teaching licensure programs, some—or perhaps even many—of these new secondary engineering educators might be experiencing low teacher self-efficacy, which research suggests would lead to relatively ineffective secondary engineering teaching. Thus, the purpose of this study was to investigate experiences/factors that might influence secondary engineering teachers' self-efficacy, to inform those who are developing new pre- and in-service secondary engineering teacher preparation programs, and educational administrators / policy-makers. The population of Project Lead the Way (PLTW) secondary engineering teachers across the U.S. was invited to participate in this study. PLTW offers the best-known secondary engineering curriculum in the U.S. It features robust linkages/articulation agreements with post-secondary engineering programs (McVearry, 2003). The data for this study were obtained by administering the *Teachers' Self- Efficacy Belief System-Self* (TEBS-S) instrument (Dellinger, Bobbett, Oliver, & Ellett, 2008) and a demographic instrument developed by the researcher. The following factors had a statistically significant influence on teacher self-efficacy: pre-PLTW teaching experience, PLTW teaching experience, post-secondary course hours completed, teacher licensure process, and current and past teaching schedules. Implications of these findings may be used by administrators and educators who are actively involved in recruiting, selecting and preparing secondary engineering educators.

Acknowledgements

"If I have the belief that I can do it, I shall surely acquire the capacity to do it even if I may not have it at the beginning."
~ Mahatma Gandhi ~

I truly believe that the individuals I have met during my journey through life were placed there for a reason and these individuals have added substance and meaning to my life. I would like to take time to say thanks to the key individuals that have added so much to my journey as well as helped with the preparation of this dissertation.

I am indebted to several individuals for their support towards the completion of my doctoral program. First and foremost, I wish to thank my advisor, Dr. Mark Sanders, for his insightful advice and support during the conduct of this study, as well as for his interest in the subject area. You have no idea how helpful your advice and ideas have been to me. You are not only my mentor, but a great friend. I also want to acknowledge Dr. John Wells and thank him for teaching a class in STEM research which led me to my dissertation topic. Your support and advice has always been appreciated. My two other committee members, Dr. Brenda Brand and Dr. Tom Williams, the wisdom and advice you shared with me during my prospectus exam helped me so much in this endeavor.

I also want to thank the Project Lead the Way organization for allowing me to have access to their PLTW teacher database. Without their assistance, this research study would have never taken place. I want to especially thank Jason Taylor from Project Lead the Way. You went beyond your responsibilities in assisting me in sending out initial and follow up e-mails to participants to assure that I received an adequate number of responses.

As I think back in time to the one individual who inspired me when I was young to believe in myself, who gave me great confidence, who completely changed my life, it would have to be Gene "*Mean Gene*" Chambers. You will never know of the inspiration that you gave. Sitting me down and informing me of my short comings, and telling me I could do much better and then to take a chance by making me your student assistant, led me to believe in myself, which is the greatest gift anyone has ever given me. Words of thanks can never describe the gratitude I have for you. To my two sons, Logan and Sam, a father could never be blessed more than I have by having you, two fine young men in my life. You have brought me so much joy and so much laughter in my life. I could never ask for two finer sons. Your encouragement in this endeavor has always been appreciated. I hope my efforts can inspire you to always further your education. Nothing in my life will be more satisfying than watching you grow up and pursue your passions of life. To my parents, how could anyone ask for greater parents than you have been to me? You have continually encouraged me and believed in me and given me support whenever I have needed it. You will never know the love I have for you as well as my lasting admiration. Last but not least, to Cheryl, my wife, I thank you for not only accepting me during such a difficult time, but for helping me to laugh, to love and to be happy in the process. You are everything to me and will be forever. I am thankful for your unconditional love and undying support and I am anxiously awaiting the journeys that await us.

Dedication

This dissertation has been a very long process and it is hard to thank all those that have helped along the way; however, I want to dedicate this work to my beautiful wife, Cheryl. When I look at you, I am always reminded of what a wonderful marriage we have. Not too often do two people find such happiness. May life take us where the four winds blow!

Table of Contents

Page

List of Tables

List of Figures

Chapter I: Introduction

The concept of teacher self-efficacy plays a key role in promoting student achievement. Ross (1994) reviewed 88 self-efficacy studies and identified possible links between teachers' self-efficacy and teaching behaviors. Ross suggested that teachers with higher levels of teacher self-efficacy are more likely to: (1) learn and use different approaches and strategies for teaching; (2) use management techniques that enhance student autonomy and diminish student control; (3) provide individual assistance to low-achieving students; (4) build students' self-perceptions of their academic skills; (5) set achievable goals; and (6) persist in the face of student failure. Teacher self-efficacy influences diverse student outcomes such as achievement (Armor et al., 1976; Chemers, Hu, & Garcia, 2001; Ashton & Webb, 1986; Moore & Esselman, 1992; Ross, 1992), motivation (Midgley, Feldlaufer, & Eccles, 1989; Muijs & Reynolds, 2001), and students' own sense of self-efficacy (Anderson et al., 1988). Teachers with a higher level of teacher self-efficacy produce increases in student achievement (Ashton & Webb, 1986), work with struggling students for longer periods of time, and develop learning environments that are more responsive to students (Woolfolk, Rosoff, & Hoy, 1990). A strong sense of teacher self-efficacy may help teachers move beyond what they do not know and focus on caring and helping their students learn (Woolfolk Hoy & Davis, 2006).

Ashton and Webb (1986) found that teachers with higher levels of teacher self-efficacy were more likely to promote effective learning environments that were student focused, while Gibson and Dembo (1984) found that teachers with higher levels of teacher self-efficacy achieved higher student participation rates by utilizing whole class instruction and were better at keeping students engaged when students were working in small groups. Cousins and Walker (1995) found that teachers with higher levels of teacher self-efficacy were open to new ideas and were willing to experiment with new methods to meet the needs of their students. Teacher self-efficacy also influences performance, commitment, and professional retention (Darling-Hammond, 2003). Teachers with higher levels of teacher self-efficacy focus on student learning, as opposed to teacher behavior. These teachers demonstrate a smaller number of concepts in a single lesson, using the extra time to facilitate student discussion, wait longer after asking questions, and ask for a larger number of student responses per question (Yerrick & Hoving, 2003). Guskey (1988) found that teachers with higher levels of teacher self-efficacy assumed greater responsibility for effective academic results from their students than for negative results, were more confident in their ability to influence positive outcomes than to prevent negative ones, and were more willing to use an innovative curriculum. In contrast to the positive impact that higher levels of teacher self-efficacy has on student performance, Ashton & Webb (1986) found that teachers with low levels of teacher self-efficacy tend to contribute poor student performance to factors such as home environments, student's lack of ability, lack of motivation, and student character flaws. Teachers with low levels of teacher self-efficacy tend to have more rigid and controlling classrooms (Woolfolk & Hoy, 1990) and ignore or denigrate students who answer questions incorrectly (Gibson & Dembo, 1984).

Statement of Problem

The presence of engineering in K–12 classrooms is an important phenomenon because of the broader implications of engineering education for the future of science, technology, engineering, and mathematics (STEM) education. K–12 engineering education may improve student learning and achievement in science and mathematics; increase awareness of engineering and the work of engineers; boost youth interest in pursuing engineering as a career; and increase the technological literacy of all students (NAE & NRC, 2009). The National Research Committee's (NRC) 2011 report, *A Framework for Science Education*, established a framework for integrating engineering into science education so students can better understand the designed world. The importance of this report is that it serves as a guideline for the revision of the NRC's National Science Education Standards, which was first published in 1996 to assist state standards developers, curriculum designers, assessment developers, state and district administrators, and those responsible for science teacher education (NRC, 2011). Similarly, the National Assessment of Educational Progress (NAEP) recently released the 2014 Technology and Engineering Literacy Framework for the National Assessment of Educational Progress. This document provides the specifications for the first national K-12 assessment of technology and engineering literacy. The Engineering Education for Innovation Act (H.R.4709-E2 for Innovation Act) would authorize the U.S. Secretary of Education to competitively award planning and implementation grants to state and educational agencies to integrate engineering education into K-12 curriculum and instruction. In this bill, emphasis is placed on introducing engineering education in order to improve student learning and achievement in science and mathematics (H.R.4709, 2010).

The increasing demand for new engineering content in K-12 education led to the development of the Project Lead the Way (PLTW) secondary engineering curriculum. PLTW is considered the premier program in the United States providing high schools with pre-engineering curriculum and linkages to college-level engineering and engineering technology programs (McVearry, 2003). PLTW teachers were selected for this study primarily because the PLTW's curriculum aligns with the five curriculum specifications outlined by the National Academy of Engineering and National Research Council (NAE & NRC, 2009). Kelley, Brenner, and Pieper (2010) and Daugherty (2006) identified PLTW as a pre-existing secondary engineering program, while Shields (2007) identified PLTW as a widely recognized pre-engineering curriculum. Since its beginning in 1996, the PLTW curriculum has expanded from 11 high school programs (primarily in upstate New York) to nearly 4,000 schools with more than 350,000 students enrolled in PLTW classes (PLTW, 2011). Bottoms and Anthony (2005) noted that the PLTW curriculum contains educational learning activities that positively affect students' learning of pre-engineering competencies. PLTW (2011) described its curriculum as an engineering curriculum that uses project and problem based learning strategies to acquaint students with the foundations of engineering design and principles as well as selected specializations in engineering (eg., biotechnical, aerospace, and civil/architecture). When combined with college preparatory mathematics and science courses, The PLTW curriculum is said to introduce students to the scope, rigor, and discipline of postsecondary engineering education. PLTW partners with dozens of postsecondary engineering institutions and has numerous other professional sponsors and partnerships, including the Academy of Engineering, Engineering Alliance, Dryden Flight Research Center of the National Aeronautics and Space Administration (NASA) and NASA's

Goddard Space Flight Center. These partners have worked with PLTW in developing effective engineering curriculum and professional engineering training for PLTW teachers (PLTW, 2011).

Teaching a K-12 engineering curriculum requires qualified teachers who are not only knowledgeable in mathematics, science, and technology, but who will develop hands-on, open-ended design experiences in which their students can solve real-world problems. Because there are essentially no teacher licensure programs in the U.S. to help prepare secondary "engineering educators" teachers to teach a K-12 engineering curriculum, a significant number of teachers with minimal or no engineering or engineering education background have been recruited to teach secondary level "engineering courses" in schools across the US. For example, there are currently more than 7,000 teachers teaching Project Lead the Way (PLTW, 2011) "pre-engineering" courses in the United States. In almost all cases, those PLTW teachers have had little or no "engineering" or "engineering education" preparation, before being employed to teach those secondary level "pre-engineering" courses. The same can be said from those teaching secondary Engineering by Design courses (ITEEA, 2011) and other "engineering" courses springing up across the United States. Qualifications to become an engineering educator are not well defined and graduates from STEM programs who may have strong backgrounds in engineering are not formally licensed in engineering education. Many teachers lack the experience or knowledge to teach engineering (Katehi, Pearson, & Feder, 2009).

In other countries where K-12 engineering has been introduced, researchers have found that experienced teachers struggle when it comes to teaching engineering activities. Stein, McRobbie, and Ginns (2002) found that teachers' knowledge was limited related to developing strategies to implement design and engineering in the classroom. Bringing engineering into a K-12 classroom requires long-term planning, since many teachers did not have previous training in teaching engineering (Yasar, Baker, Robinson-Kurpius, Krause, & Roberts, 2006). Wheatley (2002) found that uncertainty regarding the teaching of a new subject can foster negative attitudes, interfere with the teacher's learning, and reduce the use of the new teaching approaches. Jones and Nimmo (1999) state, "Transformative change, genuine learning happens only through disequilibrium, through the discovery that what I thought I knew is not enough to deal with this new situation (p 8.)." The demands and requirements to teach engineering in a K-12 classroom are much different from other content areas and a careful selection of potential candidates with little or limited engineering experience is a difficult task (Custer, Erekson, Cunningham, Hailey, & Householder, 2007). Individuals who are selected to teach an engineering curriculum are placed in an area of uncertainty where they may not be able to rely on teaching to their strengths. Teacher self-efficacy plays a critical role in this environment of uncertainty and disequilibrium. Ghaith and Yaghi (1997) and Guskey (1988) found that teacher self-efficacy is significantly related to the implementation of instructional innovations and that efficacious teachers rated innovative practices as being less difficult to implement and more beneficial to student learning than less efficacious teachers.

Since the research shows that high teacher self-efficacy promotes effective teaching and students of teachers with high-teacher self-efficacy outperform students of other teachers on a range of achievement tests (Anderson et al., 1988; Ross, 1992), understanding what leads to high teacher-self-efficacy of K-12 engineering teachers is a necessity. Extensive research suggests that teacher self-efficacy is a key predictor of intentions, choice to pursue a task, and persistence (Bandura, 1997; Gist, 1987; Gist & Mitchell, 1992; Sadri & Robertson, 1993). Maurer and Palmer (1999); Maurer and Tarulli (1994); and Noe and Wilk (1993) found that teacher self-efficacy is strongly related to a willingness to participate in training and development activities. Enochs and Riggs (1990) found that teacher self-efficacy is positively related to reform-oriented education and the use of hands-on teaching methods. Allinder (1994) found that teacher self-efficacy is positively related with a teacher's willingness to experiment and adopt teaching innovations. DeMesquita and Drake (1994) and Sarason (1990) concluded that reforms in educational practices that do not address teacher self-efficacy could be doomed.

The problem underlying this study was the lack of a knowledge base of teacher self-efficacy "levels" among the significant and increasing number of relatively ill prepared secondary engineering educators in the United States or of the factors that might positively influence the teacher self-efficacy of those teachers.

Purpose of the Study

The purpose of this study, therefore, was to examine selected experiences/factors among PLTW secondary engineering educators that might influence their teacher self-efficacy. This was done in order to inform those developing the emerging engineering teacher education preparation and professional development programs. In addition, the findings from this study should benefit educational administrators and policy makers as America seeks to increase secondary engineering content, particularly in Science (NRC, 2011) and Technology Education (ITEA, 2000).

Significance of Study

The United States is facing a national STEM education crisis reflected in the declining number of American students who receive STEM degrees (U.S. Government Accountability Office, 2005). Thirty years ago the United States ranked third worldwide in the number of science graduates; now the United States ranks 17th worldwide in the number of science graduates (Glenn Commission, 2000). Additionally, Asian universities produce eight times more engineering bachelor's degrees than the United States. Of the 2.8 million university degrees in science and engineering granted worldwide in 2003, 1.2 million were earned in Asian universities, 830,000 in European institutions, and 40,000 in American universities and colleges. A study of several hundred students who had left the STEM fields reported that about 40 percent of those college students who left the STEM fields reported some problems related to high school science preparation (Seymour & Hewitt, 1997).

Education in science, technology, engineering, and mathematics subject areas has become a matter of intense concern within the business and academic communities. Domestic and world economies depend more and more on science and engineering, but U.S. primary and secondary schools do not seem able to produce enough students who are sufficiently interested, motivated, or knowledgeable to compete and thrive in such a world (NAS, NAE, & IOM, 2007). Of undergraduates who pursue engineering, only 40 to 60% complete the degree with minorities and women being at the low end of this range. Among the bachelor's degrees awarded to African Americans, the lowest percentage of degrees is in the area of engineering and engineering technology (Aud & Fox, 2010). Of the students who change from engineering to another major, 98% of the students state that unsatisfactory teaching is the main reason (NAS, NAE, & IOM, 2007).

Although K–12 engineering education has received little attention from most Americans, including educators and policy makers, engineering education is making its way into U.S. K–12 classrooms. Today, several dozen different engineering programs and curricula are offered in school districts around the country, and thousands of teachers have attended professional development sessions to teach engineering-related coursework (NAE & NRC, 2009). A number of curricula for teaching engineering have been developed and with legislation being introduced that promotes increased emphasis on engineering education, competent educators in the classroom are essential to the success of engineering education. Since teacher self-efficacy is a significant predictor to a teacher's success, especially in teaching engineering classes where a high degree of uncertainty exists, understanding and exploring how teacher self-efficacy develops, what factors contribute to strong and positive teacher self-efficacy in varied domains, and whether educational programs can help develop positive teacher self-efficacy should be conducted (Pajares, 1997). Bandura (1993) found that self-efficacy is a better predictor of future task behavior than past task performance, abilities, or subject aptitude. For these reasons, this study sought to identify factors that influence the self-efficacy of PLTW secondary engineering educators.

Findings from this study will inform those developing the emerging engineering teacher education and professional development programs, educational administrators, and others interested in improving secondary engineering education in the U.S. and beyond. Understanding the sources and formation of self-efficacy can expand scholars' understanding of this construct as well as assist teacher educators and administrators in fostering self-efficacy (Tschannen-Moran & Woolfolk Hoy, 2001). To understand the sources of self-efficacy, an in-depth study of teachers is required to obtain the meaning that teachers attach to self-efficacy (Henson, 2001).

Research Questions[1]

1. What influence do selected demographic characteristics have on PLTW teachers' self-efficacy?
2. What influence do selected pre-PLTW teaching experiences have on PLTW teachers' self-efficacy?
3. What influence do selected PLTW teaching experiences have on PLTW teachers' self-efficacy?
4. What influence do selected in-service professional development experiences have on PLTW teacher' self-efficacy?

[1]Appendix A maps the instrumentation items to the research questions.

Assumptions and Limitations

The following assumptions and limitations applied to this study:

1. Each participant was assumed to have answered all survey questions honestly and to the best of his/her ability;
2. Participants who completed the survey may include views and perceptions that differ from non-participants;
3. Because the survey was administered through a Web-based application, participants may have been concerned about confidentiality, which may have resulted in fewer respondents (Couper, 2000).

Definition of Terms
In this research study several terms will be used and are defined below:

Academic achievement: Success in a class based on test scores and course grades.

High teacher self-efficacy: Confidence in one's own ability to affect change resulting in student achievement (Earley & Lituchy, 1991). These teachers tend to set higher goals for themselves as well as work harder and persist longer to achieve the goals that were set.

Low teacher self-efficacy: A lack of confidence in one's own ability to carry out actions that will affect change in student achievement. Difficulties are viewed as obstacles rather than challenges.

Self-efficacy: A belief in one's capabilities to organize and execute a course of action required to produce a given attainment (Bandura, 1997).

Social cognitive theory: Defines human behavior as a triadic, dynamic, and reciprocal interaction of personal factors, behavior, and the environment (Bandura, 1986, 1989). According to this theory, an individual's behavior is uniquely determined by each of these three factors.

STEM: Science, Technology, Engineering, and Mathematics (disciplines).

STEM education: Science education, technology education, engineering education, or mathematics education.

Verbal persuasion: Defined as the source of self-efficacy information by which an individual is led to believe he or she can successfully complete tasks in a specific domain through verbal suggestion (Bandura, 1997).

Vicarious experience: Being exposed to people who are similar to oneself achieve success through sustained effort increases self-efficacy beliefs, while observing those similar people fail, contributes to lower self-efficacy (Wood & Bandura, 1989).

Chapter II: Literature Review

This chapter presents theoretical perspectives and characteristics of self-efficacy. In addition, this chapter provides a historical perspective of the assessment of teacher self-efficacy.

Theoretical Perspective of Self-Efficacy

Self-efficacy evolved from the 1976 and 1977 study underwritten by the RAND corporation, where teacher self-efficacy was found to be "positively related to student achievement" (Denham & Michael, 1981). The RAND corporation study was based upon Julian Rotter's social learning theory (Rotter, 1966) in determining whether teachers believed that success or failure is due to the teacher's efforts (Armor et al., 1976). The RAND corporation study demonstrated that teachers with a high teacher self-efficacy could strongly influence student achievement and motivation. A second concept of teacher self-efficacy came from the research of Bandura (1977), who identified teacher self-efficacy as a belief in the teacher's ability to influence the teacher's performance in reaching an objective. Teacher self-efficacy influenced effort, persistence, resilience, as well as the level of anxiety or depression the teacher experienced (Tschannen-Moran & Woolfolk Hoy, 2001).

Rotter's social learning theory. When Rotter developed his social learning theory, the dominant theory in clinical psychology was Freud's psychoanalysis, which focused on an individual's instinctual motives in determining behavior. Individuals were seen as being naive to their inherent impulses, and treatment required an understanding of repressed childhood experiences. Even learning approaches at this time were dominated by drive theory, which held that people are motivated by physiologically-based impulses that drive the individual to satisfy these impulses. In developing the social learning theory, Rotter departed from the psychoanalysis theory and drive-based behaviorism. Rotter believed that a psychological theory should have a psychological motivational principle. Rotter chose the empirical law of effect as his motivating factor. The empirical law of effect stated that people are motivated to seek out positive stimulation and reinforcement and to avoid unpleasant stimulation. Rotter believed that personality was formed through the individual's interaction with his or her environment (Rotter, 1954). By changing an individual's environment, the result would be a change in the individual's behavior. However, as the individual resides within his or her environment over extended periods of time, change becomes more difficult and additional intervention and effort are necessary to cause a change in behavior. Pintrich and Schunk (2002) in describing Rotter's theory, stated,

> In essence, Rotter's theory says that people form expectations about the likely outcomes of behaviors and can act in accordance with these expectations and the value they place on potential outcomes. Individuals will act in a given fashion if they believe that a reinforcing outcome will occur and if they value that outcome (p. 147).

Rotter developed four main components to his social learning theory model: behavior potential, expectancy, reinforcement value, and the psychological situation.

Behavior potential is the probability that an individual will engage in a certain behavior when faced with a certain situation. Since numerous behaviors could be viable when an individual is faced with a situation, a behavior potential will exist and the individual will engage in the behavior that has the highest potential for success (Rotter, 1954).

Expectancy is based upon the probability that a behavior will lead to a specific outcome. If the individual faces a situation where outcomes are of equal value to the individual, the individual will choose behaviors that have the highest probability of being successful. Expectancies are based upon the experience that the individual has observed in the past in which one of their behaviors produced a specific result. For example, a teenager might choose to purchase a specific brand of shoe, because an experience has demonstrated that this behavior will lead to greater acceptance among their peers. Subjectivity can significantly affect expectancy in that the individual's perception of one's behavior may be irrational and the result of their behavior may be different that the reality of the outcome (Rotter, 1954).

Reinforcement values are based upon an individual's preference in seeking a specific outcome. Outcomes that the individual desires are given higher values than outcomes the individual finds to be undesirable. If the probability is the same for two different outcomes, the individual will choose the outcome that has the highest reinforcement value. Reinforcement values can be internal as well as external; where internal reinforcements are based upon the individual's perception of the reinforcements; external reinforcements are based upon society's perception of the reinforcements. Reinforcement values can also be highly subjective in that the desirability of an outcome can vary among individuals based upon the individual's needs. A student may cause distractions to a class knowing they will be obtaining punishment from a teacher to gain a positive reinforcement outcome among their peers (Rotter, 1954).

Rotter's fourth component, psychological situation, is the interaction between an individual's expectations and the individual's values with the environmental constraints. This interaction places a powerful influence on the individual's behavior. The subjective interpretation of the environment around an individual may be the determining factor in that individual's behavior instead of behavior being determined by objective reasoning (Rotter, 1954).

Rotter's locus of control theory. Rotter's locus of control theory is based upon how an individual's decisions are influenced. An individual who primarily makes their own choices with little influence from others is considered to have an internal locus of control. An individual who makes decisions based more on the influence of others is said to have an external locus of control. Individuals with a strong internal locus of control believe that they are responsible for their own success or failure through their own efforts. Individuals with external locus of control believe their success is based upon fate, luck, chance, or the influence of others (Rotter, 1966). Males tend to have higher internal locus of control than females and as males become older, males tend to increase their internal locus of control (Mamlin, Harris, & Case, 2001). Research has shown that having an internal locus of control is related to higher academic achievement. Students with internal locus of control tend to earn better grades and work harder on homework and studying for exams, because they view their efforts as being directly related to expected results (Findley & Cooper, 1983). Kaiser (1975) found that individuals with an internal locus of control attributed their grades on an exam to internal reasons while individuals with external locus of control attributed their grades to external factors. What can cause an individual to develop an external locus of control? According to Bender (1995), "Continued failure in spite of continued attempts at school tasks leads to an external locus of control. Further, a high external locus of control, in turn, leads to a lack of motivation for study and school in general." An individual who has an external locus of control may feel that working hard in school is pointless because his or her past efforts have only brought frustration and disappointment. This situation tends to cause individuals to fail at reaching their full academic potential due to the concept that factors are out of their control. Individuals with an external locus of control are also more likely to also suffer from depression because they believe their actions cannot alter their current position (Yang & Clum, 2000).

Bandura's social cognitive theory. Albert Bandura's social cognitive theory was a result of Bandura's work with Rotter's social learning theory. Bandura placed heavier emphasis on how individuals operate cognitively within their social experiences. In 1986, Bandura renamed his theory, the social cognitive theory and officially launched it with his book, *Social Foundations Thought and Action: A Social Cognitive Theory*. The social cognitive theory presented the learner as being integrated within his or her learning environment, where the learner's cognitive responses, behaviors, and environment worked in unison to facilitate learning. While the social cognitive theory maintained the concept presented by the behavioral theory that response consequences directed behavior, the social cognitive theory asserted that behavior was primarily regulated through cognitive processes (Bandura, 1986). According to Jones (1989),

> The fact that behavior varies from situation to situation may not necessarily mean that behavior is controlled by situations but rather that the person is construing the situations differently and thus the same set of stimuli may provoke different responses from different people or from the same person at different times.

Social cognitive theory is based upon the concept of human agency where individuals are actively engaged and can control their own learning development by their actions and behavior. With agency, individuals have within themselves the ability to control their thoughts, feelings, and actions, "what people think, believe, and feel affects how they behave" (Bandura, 1986, p. 25).

Triadic reciprocal determinism. Social cognitive theory is based upon the premise of bi-directional causation in which internal personal factors such as cognitive, affective, and biological events; behavioral patterns; and environmental events interact and influence one another bi-directionally (Bandura, 2001). Social cognitive theory differentiates between three types of environmental structures including the imposed environment, selected environment, and constructed environment (Bandura, 1997). The imposed environment is forced upon individuals and they have exceedingly little control over these environments; however, the individual does have control over how they observe and respond to these environments. The environment serves only as a potential presence with potential rewards and punishments and the environment's influence or response does not exist until the individual sets a course of action within that environment (Bandura, 2001). Bandura contends that individuals are both products and producers of their environment (Bandura, 1977). An individual's behavior affects the way they experience an environment through their selective process and determines the type of environments that will come into play and the environmental characteristics that will be produced (Bandura, 1989). To fully understand the concept of triadic reciprocal determinism, Bandura (1986, 1997) developed the following model. (See Figure 1).

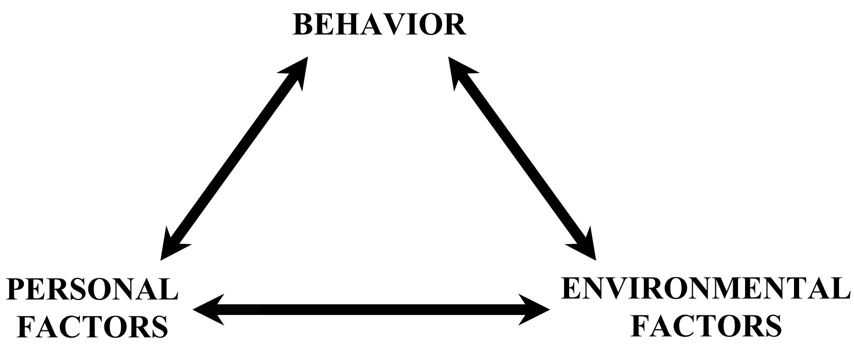

Figure 1. Theoretical Model of Triadic Reciprocal Causation. (Bandura, 1977. p. 6).

Self-Efficacy Theory

Origins of self-efficacy. The concept of self-efficacy can be traced back to Bandura's (1977) article titled, *Self-Efficacy: Toward a Unifying Theory of Behavioral Change*. Bandura presented self-efficacy as a means of behavioral change and self-regulation. Bandura viewed self-efficacy as one's belief in their perceived ability to initiate action that will lead successfully to a specific goal. Bandura proposed that self-efficacy beliefs were strong predictors of behavior and studies in self-efficacy have supported Bandura's hypothesis (Pajares, 1997; Tschannen-Moran, Woolfolk, Hoy, & Hoy, 1998). Positive self-efficacy beliefs tend to drive individuals toward success rather than their actual abilities (Bandura, 1986, 1997). Self-efficacy beliefs provide the basis for human motivation, well-being, and personal accomplishment. Unless people believe that their actions can cause the outcomes they desire, they have little incentive to act or to persist in the face of difficulties (Pajares, 2002).

Defining self-efficacy. Bandura defined self-efficacy as, "the belief in one's capability to organize and execute the courses of action required to manage prospective situations" (Bandura, 1997). However, researchers often use other terms interchangeably with self-efficacy. The terms self-concept or self-esteem should not be confused with self-efficacy. Self-concept or self-esteem is based upon an individual's sense of self-worth (Pajares, 2002). Self-efficacy is a context specific assessment to perform a specific task or series of tasks within a domain. Self-concept or self-esteem is a cognitive appraisal across different dimensions that the individual contributes to themselves (Pajares, 2000). Confidence also cannot be used interchangeably with self-efficacy. Confidence is a non-descriptive term that refers to the depth of one's belief, but does not specify the certainty of that belief. Self-efficacy is both an affirmation of one's proficiency as well as the strength of that belief (Bandura, 1997).

Self-efficacy and human agency. Bandura (2001) considered self-efficacy as the most critical mechanism of agency. He defined agency as an intentional act, with its main feature being the ability to formulate actions for given purposes. "Whatever other factors may function as guides and motivators, they are rooted in the core belief that one has the power to produce effects by one's actions" (p.10). Individuals have an influence over their own personal behavior; however, many factors affect this behavior. Individuals tend to contribute toward what happens in their lives instead of being able to determine what happens to them (Bandura, 1977). Bandura believed that "a strong sense of personal agency requires the development of competencies, self-percepts of efficacy, and self-regulatory capabilities for exercising self-directedness" (Bandura, 1977, p. 38). Agency can be seen as a purposely driven effort to develop one's future. Human agency operates under the three separate bi-directional factors of the triadic reciprocal model: behavior, personal factors, and environmental factors (Bandura, 1986, 1997). Beliefs of personal efficacy develop the main factors of human efficacy (Bandura, 1997). If individuals believe they can affect results, they will be more likely to pursue a course of action to produce results. If they lack these beliefs, they will not make the effort.

Sources of self-efficacy. Bandura (1977) described four sources where human behavior influences self-efficacy. These included: mastery experience, vicarious experience, verbal persuasion, and physiological states.

The most significant source of self-efficacy is mastery experience in which the individual monitors the result of one's actions and the interpretation or understanding of these effects creates self-efficacy. Bandura (1977) determined that mastery experiences influence self-efficacy the most in that, "they provide the most authentic evidence of whether one can muster whatever it takes to succeed" (Bandura, 1997, p. 80). Successful results raise self-efficacy, while unsuccessful results lower self-efficacy (Pajares, 1997). The perception that one's performance or actions contributes to success raises self-efficacy and builds a robust belief in one's ability. Failure can undermine self-efficacy, especially when failure occurs prior to a sense of self-efficacy being firmly established. Self-efficacy is increased if an individual attributes one's success to one's ability; however, self-efficacy may not increase if an individual attributes one's success as a result of luck or through the actions of others (Bandura, 1993; Pintrich & Schunk, 1996). Bandura (1977) found the impact of an occasional failure on self-efficacy is minimized once self-efficacy has been established through continual success. An occasional failure that the individual may overcome through focused, determined effort strengthens self-motivation. After an individual becomes convinced they have within them the ability to succeed, they tend to persevere when faced with adversity. By working through difficult situations, the individual becomes stronger as a result of the experience (Bandura, 1977).

Vicarious experience is obtained when an individual observes another individual performing a task. Even though vicarious experience may have a weaker connection to self-efficacy than mastery experience, individuals who have little prior experience regarding a task or who are uncertain about their abilities, tend to be influenced by vicarious experience (Pajares, 1997). If an individual sees that others can be successful, they tend to believe they should be able to improve their own performance. If the observer identifies strongly with a successful participant, then there will be a stronger influence on the self-efficacy of the observer (Bandura, 1977). Modeling plays an important role in the vicarious experience. Modeling that has clear, specific outcomes influences the self-efficacy of the observer (Bandura, 1977). The effect of modeling on perceived self-efficacy is strongly influenced by the degree of similarity that the individual perceives with the model. If the individual perceives a strong similarity with the model, then the more persuasive are the model's successes and failures. If the individual perceives the model as being quite different, then the individual's perceived self-efficacy is not influenced to a high degree by the model's actions. Even experienced and self-efficacious individuals increase their self-efficacy values when they observe improved methods of accomplishing a task while observing a successful modeling approach (Pajares, 1997). Observing modeling where the participant fails to meet his or her objective can have a negative impact on the observer's self-efficacy. If the observer sees a similarly competent individual fail despite intense effort, then the observer tends to lower their own capabilities (Brown & Inouye, 1978). However, if the observer views himself as being superior to the participant, then the participant's failure will not have a negative influence on the self-efficacy of the observer (Pajares, 1997).

Self-efficacy can also be improved through verbal persuasion, even though verbal persuasion is a weaker source than mastery experience or vicarious experience. In the words of Bandura, "Verbal persuasion alone may be limited in its capacity to create enduring increases in perceived efficacy, but it can reinforce self-change if the positive appraisal is within reasonable bounds" (Bandura, 1997, p. 101). Individuals are more likely to put forth a greater effort and maintain that effort if the individual has been told verbally that they have within them the ability to accomplish a given activity. Verbal persuasion tends to encourage individuals to put forth effort to succeed which promotes self-efficacy. However, if overly, optimistic comments are given to an individual and the individual ultimately fails, the persuader is discredited and the individual's self-efficacy is reduced. Undermining self-efficacy through persuasion is easier than promoting an individual's self-efficacy through persuasion. Individuals who are told they lack abilities tend to avoid challenging activities and tend to give up easier (Bandura, 1977, 1997).

The fourth source of self-efficacy presented by Bandura is the individual's physiological and emotional state. Bandura (1986, 1997) described how individuals rely on their own physiological and emotional states in determining their capabilities in accomplishing a task. Individuals interpret physiological states where they experience increase heart rates, sweating, hyperventilation, and anxiety as being unpleasant, and these physiological states affect self-efficacy. Emotional states such as fear, excitement, betrayal, and anxiety also affect self-efficacy. Since physiological and emotional states influence self-efficacy and can affect performance, an individual is more likely to expect success when they are not overcome by physiological and emotional stress factors than if they are "tense and viscerally agitated" (Bandura, 1997, p.106). What is noteworthy is not the intensity of the emotional and physical response of the individual, but the perception and interpretation of these emotional and physical states. Individuals who have a high self-efficacy tend to view these emotional and physical states as an energizing factor in their performance, while individuals with low self-efficacy views these same emotional and physical states as a debilitating factor in their performance (Bandura, 1997).

Characteristics of self-efficacy. Individuals with strong self-efficacy tend to improve their well-being as well as the well-being of others who are interacting with these individuals. Individuals with strong self-efficacy approach a challenge to be mastered rather than to be avoided. These individuals have greater intrinsic interest in activities, set challenging goals, and maintain a strong commitment to these goals. When these individuals face failure, they heighten their efforts, easily recover their confidence after failures or setbacks, and attribute failure to insufficient effort or deficient knowledge and skills which they believe they are capable of acquiring (Pajares, 1997). "Research shows that people who regard themselves as highly efficacious act, think, and feel differently from those who perceive themselves as inefficacious. They produce their own future, rather than simply foretell it" (Bandura, 1986, p. 395). Individuals with low self-efficacy tend to believe that things are tougher than they actually are. This belief creates stress and limits the individual's focus on solving the problem. "By contrast, persons who have a strong sense of efficacy deploy their attention and effort to the demands of the situation and are spurred by obstacles to greater effort" (Bandura, 1986, p. 394). Strong self-efficacy has been shown to have a significant effect on the level of motivation and amount of extended effort an individual places in achieving a goal. High levels of self-efficacy are associated with an increased level of goal setting, which leads to a firmer commitment in achieving goals that have been set and greater resolve to persevere in the face of obstacles (Bandura, 1989).

Teacher Self-Efficacy

The origin of teacher self-efficacy. Based upon Rotter's research in developing the social learning theory (Rotter, 1966), teacher self-efficacy began with RAND researchers' evaluation of whether teachers believed they could control the reinforcement of their actions (Armor et al., 1976). The concept of external controls presented by Rotter applied to teachers who believed their environment could overwhelm their ability to have an impact on a student's learning and therefore they saw this environment as being an external control. The concept of internal controls, discussed by Rotter, applied to teachers who had the confidence to teach difficult or unmotivated students, believed in their own abilities, and saw teaching activities as a factor that was within their control (Tschannen-Moran, Woolfolk, Hoy, & Hoy, 1998).

In the RAND study, researchers investigated the role that self-efficacy had on teaching effectiveness. Self-efficacy was measured by asking two questions, (a) "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment," and (b) "If I try really hard, I can get through to even the most difficult or unmotivated students." The first question was conceived to determine outcome expectations or teacher self-efficacy. The second question attributed to personal teaching efficacy. Self-efficacy related to the teacher's outcome expectations while personal teaching efficacy referred to the teachers sense that his or her ability could influence student learning. Early RAND researchers placed significant emphasis on outcome expectations and personal responsibility when looking at efficacy scores, and student motivation and performance were assumed to be significant factors to strengthen teaching behavior (Armor et al., 1976). Ashton and Webb (1986) saw a connection between self-efficacy and the social cognitive approach, and placed greater emphasis on the connection between self-efficacy and outcome expectations.

A second theory emerged in 1977 from the theory of social learning in which Bandura pioneered the concept that behaviors are intimately associated with one's beliefs (Bandura, 1977). Bandura believed that behavior can be more accurately predicted by the belief that one has in their capabilities, rather than what they can actually accomplish. Self-efficacy, as referred to by Bandura, was seen as the perceptions that one has in their capabilities.

Even though some confusion does exist as to the theoretical aspects of teacher self-efficacy, teacher self-efficacy is still viewed as a contributing variable in educational research. Woolfolk and Hoy (1990) noted, "Researchers have found few consistent relationships between characteristics of teachers and the behavior or learning of students. Teachers' sense of efficacy . . . is an exception to this general rule" (p. 81).

The concept of teacher self-efficacy. Teacher self-efficacy was originally defined as "the extent to which the teacher believes he or she has the ability to affect student performance" (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977, p. 137). Tschannen-Moran & Woolfolk Hoy (1998) defined teacher self-efficacy as "teacher's belief in his or her own capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (p. 233). Tschannen-Moran and Woolfolk Hoy (2001) defined teacher self-efficacy as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated." Based on Rotter's theory, teachers who felt that outside factors had a greater influence on their ability to affect student learning held a belief that reinforcement of their actions were outside of their external locus of control. Teachers who had confidence in their abilities to teach unmotivated students and produced positive results held a belief that reinforcement of teaching was directly related to their internal locus of control. Bandura (1997) identified teacher self-efficacy as a type of self-efficacy related to his social cognitive theory that had an efficacy expectation and an outcome expectation. Efficacy expectancy is based upon one's perceived value of their performance. Outcome expectancy was one's perceived consequence of their performance. Perceived self-efficacy is typically a stronger predictor of behavior than outcome expectation (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998).

Predictors of teacher self-efficacy. In predicting teacher self-efficacy, novice teachers who have strong scientific content knowledge which is typically demonstrated through the number of completed science classes (Cantrell, Young, & Moore, 2003; Ramey-Gassert, Shroyer, & Staver, 1996), possessing a science degree (Desouza, Boone, & Yilmaz, 2004), being able to accurately answer commonly misunderstood science questions (Schoon & Boone, 1998), and exhibiting low levels of anxiety toward the teaching of science (Bursal & Paznokas, 2006), have higher teacher self-efficacy toward the teaching of science. In contrast, novice teachers who took the minimum required number of science courses felt that their content knowledge was lacking (Bohning, Hale, & Chowning, 1999). As a result, novice teachers tend to avoid teaching in subject areas where they were uncomfortable and often fear that their students will ask them questions that they cannot answer (Mulholland & Wallace, 2001; Tosun, 2000). The relationship that exists between content knowledge and self-efficacy has been explained through the "success breeds success" adage (Ramey-Gassert et al., 1996). In short, teachers who are knowledgeable about science typically feel comfortable sharing their understanding of science with their students and have a high expectancy that their students will be able to learn from them. One area of concern is that many university science courses are taught through direct lectures and students (future teachers) never have the opportunity to observe how to integrate hands-on learning in a scientific course. When they become teachers within their own classroom, they lack pedagogical content knowledge (Huinker & Madison, 1997; Plourde, 2002; Rice & Roychoudhury, 2003). The result is high teacher anxiety due to the teacher's unsuccessful science experiences and limited exposure to teaching strategies other than direct lectures. This anxiety is dominant among teachers who express very low teacher self-efficacy. Lumpe, Haney, & Czerniak (2000) found a direct correlation between the number of teaching strategies utilized in teaching science and science self-efficacy. Novice teachers' ratings of their teacher preparation programs have been positively correlated with their science teacher self-efficacy (Knobloch & Whittington, 2002). Ross (1998) found that a novice teacher's self-efficacy was higher when the novice teacher had a master's degree in science education over a bachelor's degree in science education.

Pedagogical knowledge relating to teacher self-efficacy. Limited research exists related to pedagogical knowledge and pedagogical beliefs with teacher self-efficacy. Raudenbush, Rowan, and Cheong (1992) demonstrated that pedagogical knowledge and teacher self-efficacy must be utilized together for effective teaching to occur. Raudenbush et al. (1992) found that positive teacher self-efficacy is related to positive teaching strategies and maintaining persistence; however, positive teacher self-efficacy alone was not sufficient for effective teaching. Raudenbush et al. (1992) concluded:

> … this perspective feelings of positive self-efficacy cannot guarantee effective teaching, since teachers with high levels of perceived self-efficacy may lack the requisite knowledge or skills to be effective. But, low feelings of self-efficacy almost certainly work against effective teaching by decreasing teachers' generative capability to cope with the uncertainties of classrooms (Raudenbush et al., 1992, p. 151).

Of the limited research that has been conducted, individuals with higher levels of knowledge tend to have higher levels of self-efficacy (Benz, Bradley, Alderman, & Flowers, 1992; Minke, Bear, Deemer, & Griffin, 1996; Schoon & Boone, 1998; Sciutto, Terjesen, & Bender Frank, 2000). Schoon and Boone (1998), testing pre-service teachers on alternative conceptions of core science principles, found that the pre-service teachers with the most correct answers reported higher feelings of science teaching self-efficacy, while teachers that believed in alternative conceptions of science tended to have lower levels of science teaching self-efficacy (Fives, 2005).

Pedagogical beliefs relating to teacher self-efficacy. Few studies have been done on pedagogical beliefs in relationship to teacher self-efficacy. Fives and Alexander (2004) divided pedagogical beliefs into two categories related to teacher self-efficacy: ontological orientations and specified beliefs. Ontological orientations refer to how teachers perceive the world (Fives & Alexander, 2004). Anderson et al. (1988) found that practicing teachers who believed in using problem solving strategies toward teaching were more likely to express higher levels of teacher self-efficacy than those who held a more traditional belief system. Payne (1994) found that open-minded urban teachers reported higher levels of teacher self-efficacy. Woolfolk and Hoy (1990) found that pre-service teachers, who believed that teachers could influence student learning, were more likely to see the school as an educational community in which students learn through cooperative interaction as compared to those with lower teacher self-efficacy (Fives &

Alexander, 2004). McKinny et al. (1999) evaluated the role of teacher self-efficacy in the process of change in teachers' practice. This study demonstrated that teachers with lower levels of teacher self-efficacy were more concerned with how reform intervention affected their own teaching experience than teachers with higher levels of self-efficacy.

Teacher self-efficacy and student engagement. Teachers with a strong sense of teacher self-efficacy tend to exhibit greater levels of planning, organization, and enthusiasm (Allinder, 1994). Teachers are also more willing to be open to new ideas and are more willing to experiment with new methods to better meet the needs of their students (Guskey, 1988, Stein & Wang, 1988). Teachers with high levels of teacher self-efficacy are less critical of students when they make errors (Ashton & Webb, 1986), work longer with a student who is struggling (Gibson & Dembo, 1984), and are less inclined to refer a difficult student to special education (Meijer & Foster, 1988; Soodak & Podell, 1997). Ashton and Webb (1986) found that teachers with low teacher self-efficacy were unable to get students interested in academic work and were often unwilling to challenge students as well as monitor their students' academic performance. Ramey-Gassert et al. (1996) found that teachers with low teacher self-efficacy, who had limited success in science, tended to empathize with their students that science was difficult to understand. Ramey-Gassert et al. (1996) found that teachers with low teacher self-efficacy perpetuated their beliefs that "science was too hard for me, and it's too hard for my students." In contrast, teachers with high teacher self-efficacy spoke of strong science backgrounds at home and through coursework as well as high interest in science. Teachers with high teacher self-efficacy demonstrated the ability to help all students succeed and communicated to their students the high expectations for academic performance. Because of this, their students were observed to be consistently more on task than low self-efficacy teachers (Milner & Woolfolk Hoy, 2003; Ashton & Webb, 1986).

Regarding questioning techniques to promote student engagement, Gibson and Dembo (1984) observed that teachers with low teacher self-efficacy responded more negatively to students' incorrect responses than teachers with high teacher self-efficacy. When students respond with incorrect answers, teachers with low teacher self-efficacy tend to respond to these students by giving the correct answer, asking another student, or allowing other students to respond to the question. Teachers with high teacher self-efficacy tend to lead students to correct responses through questioning strategies and are more open to the use of small groups in discussing potential solutions, thus resulting in improved student engagement.

Teacher self-efficacy and individual differences. De Laat and Watters (1995) found that teachers with high teacher self-efficacy tend to develop problem solving activities and logical thinking skills for realistic situations and utilized hands-on learning opportunities to learn science. Teachers with high teacher self-efficacy also developed their own curriculum instead of utilizing the recommended curriculum and tended to use student-centered strategies that promoted students' conceptual understanding. Teachers with low teacher self-efficacy utilized instructional strategies that tended to be more teacher focused, such as standard lectures. These teachers tended to not use educational theory or published research to substantiate their instructional strategies, seemed more concerned about managing student behavior than promoting learning, and were more concerned about strategies that might be interesting or fun.

De Laat and Watters (1995) observed that teachers with low science teaching self-efficacy lacked an understanding of the potential that science education brings outside the classroom and tended to teach science within an exceedingly narrow spectrum. Vinson (2001) found that the pre-service teachers felt that mathematics was the most difficult subject to teach and these teachers believed that inborn tendencies caused success in mathematics, as opposed to teacher effort or utilization of effective teaching strategies.

Teacher self-efficacy and a positive classroom climate. Doyle (1986) suggested that one of the two crucial tasks of teaching is the ability to establish and maintain order in the classroom. This task is extremely difficult for novice teachers and many list maintaining classroom discipline and motivating students as among their greatest frustrations (Veenman, 1984). Hoy and Woolfolk (1989) found a correlation between teacher self-efficacy in novice teachers and their ability to motivate and manage students. Pupil control can be managed between two extremes, a custodial approach and a humanistic approach (Willower, Eidell, & Hoy, 1967). The custodial approach is based upon maintaining an atmosphere of strict control based upon: impersonality, pessimism, punishment, and student mistrust. The humanistic approach is where students learn through cooperative interaction and where self-discipline serves as the control mechanism. Teachers who employ a more custodial approach tend to be more rigid and inflexible in their beliefs, traditional in their family values, and less progressive in their educational attitudes (Woolfolk & Hoy, 1990). Barfield and Burlingame (1974) found that teachers with low teacher self-efficacy were more custodial when it comes to controlling their students. As teachers become more experienced, they tend to become more custodial in their classroom management (Hoy & Rees, 1977; Woolfolk & Hoy (1990); Hoy & Woolfolk, 1989). Woolfolk & Hoy (1990) found that individuals who expect to be effective teachers tend to be more humanistic about controlling students. These teachers expect to deal with their students in a personal and humanistic approach. Woolfolk and Hoy (1989) stated, "Believing that one will be effective, humanistic, and comfortable in the bureaucratic surroundings of the school may be part of an optimistic and idealistic view of teaching."

Self-efficacy and motivation. Bandura (1997) concluded that motivation is a system of self-regulatory mechanisms that includes: selection, activation, and sustained direction of behavior toward achieving specific goals. Motivation has been defined by social cognitive researchers as a process in which goal-directed behavior is instigated and sustained (Pintrich & Schunk, 2002). The relationship between self-efficacy and motivation tends to be reciprocal. As a teacher or a student works on task, they tend to evaluate their process of learning. The belief that they understand the material strengthens their self-efficacy, which results in an increase in their self-efficacy and causes students to perform and persist in activities that they believe will result in learning. High self-efficacy provides individuals with a sense of agency to motivate their learning through use of self-regulatory processes such as self-monitoring, goal setting, self-evaluation, and strategy use (Zimmerman, 2000). In terms of effort, two measures have typically been employed in research: rate of performance and expenditure of energy (Zimmerman, 1995). There is supporting evidence for the association between self-efficacy and both indexes. Schunk and his colleagues showed that students' perceived self-efficacy for learning correlates positively with their rate of solution of arithmetic problems (Schunk, 1981; Schunk & Hanson, 1985).

The more confident a person views themselves to be, the more challenging the goals they are willing to take (Zimmerman, Bandura, & Martinez-Pons, 1992). Zimmerman and Bandura (1994) found that when self-efficacy and personal goal setting were compared with the verbal score of the Scholastic Aptitude Test, there was an increase of 35% in predicting college students' final grades in a writing course. According to Bandura (1993), individuals tend to make decisions based on their perceived self-efficacy by choosing activities and situations within their capabilities for success, while activities associated with failure are avoided. Individuals who have high self-efficacy put forth considerably more effort to succeed, even when faced with obstacles, than individuals with low self-efficacy. According to Bandura (1997), self-efficacy is strengthened through success, while repeated failure weakens one's self-efficacy; especially if the failures occur early in the sequence of events, such as a teacher beginning the process of teaching. According to Bandura (1997), "perceived self-efficacy is often a better predictor under variable conditions than past performance, because efficacy judgments encompass more information than just the executed action" (p.81). Collins (1982) selected children who evaluated themselves to have high or low self-efficacy in mathematical ability. These children were then given mathematical problems to solve. Children who had stronger self-efficacy beliefs tended to reject faulty mathematical strategies, solved more problems, chose to rework problems they had missed, and did so more accurately than children of similar ability who doubted their self-efficacy. In higher education settings, Pajares (1996) reported that the self-efficacy of college undergraduates in the areas of mathematics was a better predictor of their mathematics interest and majors than their prior mathematical achievements. According to Zimmerman et al. (1992), academic self-efficacy affects performance directly, as well as indirectly, related to students' goals. Pintrich & Garcia (1991) found that students, who believe they are capable of performing academic tasks, tend to employ more cognitive and metacognitive strategies and tend to persist longer on the task than students who believe they are less capable.

Teacher self-efficacy and student achievement. Teacher self-efficacy has been found to be a strong predictor of student achievement. Sadker & Sadker (1995) found that, starting in seventh grade, girls underestimate their abilities in math and science courses, while several studies (Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Pintrich & DeGroot, 1990; Smist, Archambault, & Owen, 1997; Tippins, 1991) demonstrated that female students have lower self-efficacy in math and science compared to male students. Kennedy (1996) found that self-efficacy in mathematics can shape the future career choices made by students. Students with higher self-efficacy in mathematics receive better grades in college and are more likely to major in a science field (Astin & Sax, 1996). Students who have high self-efficacy tend to try more difficult tasks and persist longer on these tasks. Achievement is perceived as a result of the student's abilities (Bandura, 1986). "…Those who regard themselves as inefficacious shy away from difficult tasks, slacken their efforts and give up readily in the face of difficulties, dwell on their personal deficiencies …lower their aspirations, and suffer much anxiety and stress. Such self-misgivings undermine performance…" (Bandura, 1986, p. 395).

Ashton (1984) found that teachers who believe they can affect their students' performance will typically show an increase in their own enthusiasm and persistence when working with their students. Students of teachers with high teacher self-efficacy outperform students of other teachers on a range of achievement tests (Anderson et al., 1988, 1988; Ross, 1992). Gibson and Dembo (1984) found that teachers with high teacher self-efficacy persist longer with struggling students and criticize them less even after the students give incorrect answers. Teachers with high teacher self-efficacy tend to organize and plan for their students to learn, set goals for themselves and their students, and identify and implement strategies to achieve these academic goals. Teachers with low teacher self-efficacy plan less and tend to set fewer goals for their students that will enhance learning. Teachers with high teacher self-efficacy believe the teacher is responsible for their students' success, while teachers with low teacher self-efficacy tend to view their students' failures on factors such their student's abilities, student's family background, and the student's attitude (Ashton, 1984).

Teachers with high teacher self-efficacy are more open to new ideas and are willing to consider a variety of approaches to meet their student's needs (Berman et al, 1977). Teacher self-efficacy has been shown to be related to classroom behaviors in which teachers with high teacher self-efficacy use praise rather than criticism, persevere when working with low achievers, and tend to be accepting of their student's opinions (Ashton & Webb, 1986; Gibson & Dembo, 1984). Ashton and Webb (1986) found that teachers with higher teacher self-efficacy were more inclined to support learning environments that were more responsive to students, while Gibson and Dembo (1984) found that teachers with higher teacher self-efficacy were more likely to encourage learning through small groups.

There also appears to be a relationship between teacher's content-specific self-efficacy and student performance. Researchers have found that mathematics and science teachers who have good conceptual understanding of their fields tend to emphasize conceptual explanations to their students and tend to shy away from subject textbooks to enhance student learning, while teachers with low self-efficacy tend to rely heavily on prepared texts. Grossman, Wilson, & Shulman (1989) found that elementary teachers who had firm conceptual understanding of mathematics tended use word problems more often, displayed a greater understanding of their student's problem solving strategies, and produced students that performed better in mathematical problem solving. Teachers who were rated as having higher teacher self-efficacy had students with improved achievement scores in mathematics and a greater number of students interested in school (Tracz & Gibson, 1986; Ross & Cousins, 1993).
The relationship between subject specific self-efficacy and subject specific performance is stronger than between academic self-efficacy and academic achievement (Marsh, 1990; Marsh, Barnes, Cairns, & Tidman, 1984; Marsh, Byrne, & Shavelson, 1988). Marsh and O'Neill (1984) reported that the mathematical achievement levels of high school students were strongly related to their mathematical self-efficacy. When comparing mathematical achievement to academic self-efficacy, the strength of this relationship decreased.

Researchers have also been successful in demonstrating that teacher self-efficacy is positively related to and influences academic achievement. A meta-analysis of studies published between 1977 and 1988 revealed that teacher self-efficacy was positively related to academic achievement (Multon, Brown, & Lent, 1991). Teacher self-efficacy was related to academic outcomes (r_u = .38) and accounted for approximately 14% of the variance. Effects were stronger for high school (*d* = .41) and college students (*d* = .35) than for elementary students (*d* = .21) Pajares & Schunk (2001).

The influence of collective efficacy. Collective efficacy is a group characteristic and is a product of the group dynamics (Goddard, Hoy, & Woolfolk Hoy, 2000). Collective efficacy represents the group's perceptions concerning the ability of the group (Bandura, 1997). Bandura's (1986, 1997) social cognitive theory, through its utilization of human agency, provides insight into the concept of collective efficacy. Since human or personal agency functions in a system where agency can be influenced by social factors and social relationships, the concept of collective efficacy can be formed through the perception that individuals have regarding the group's ability in working together to produce desired results (Bandura, 1997). Bandura (1993, 1997) was one of the first researchers to assert that collective efficacy varies considerably among schools and is directly related to student achievement. Schools that have structured leaning environments, where teachers set high but achievable goals, and where students work hard and respect others, do well academically, even controlling for socioeconomic level (Hoy, Sweetland, & Smith, 2002).

Goddard, Hoy, and Woolfolk Hoy (2000) found that student achievement was related to collective efficacy and that student achievement was affected by variations in collective efficacy. Bandura (1993), in his study of collective efficacy and student achievement developed two important findings: (a) student achievement is significantly and positively related to collective efficacy, and (b) collective efficacy has a greater impact on student achievement than the student's social economic status. Teachers' perceived collective efficacy changes dramatically through different grade levels. In the elementary grades, where academic demands are minimized, teachers demonstrate a lower sense of self-efficacy in promoting learning. As students become more accustomed to school routines and academic demands continue to be non-rigorous, teachers express a stronger sense that their school is successful in educating their students. At higher-grade levels, where academic demands increase and students experience more difficult challenges, teachers view their schools as declining in instructional efficacy (Bandura, 1993). This decline in instructional efficacy affects teachers' perceived self-efficacy, which in turn affects how well students manage school transitions (Midgley et al., 1989).

Characteristics of the student body such as low socioeconomic levels, high student turnover, and absenteeism affects the collective efficacy of the school resulting in lowering academic achievement levels (Bandura, 1993). Goddard, Hoy, and Woolfolk (2000), in a study of 97 high schools in Ohio found that collective efficacy was more important than the school's socioeconomic level in explaining achievement levels. When collective efficacy was high, a strong focus on academic pursuits not only affects the persistent behavior of the teachers in the school, but also reinforces a framework of shared beliefs by teachers and students.

Variations in teacher's self-efficacy over time. Research based on teacher self-efficacy has provided an understanding of the relationship of teacher self-efficacy to teacher behaviors as well as an understanding of the influence teacher self-efficacy has on student outcomes. Even with this research base, little has been done to study the development of teacher self-efficacy and whether teacher self-efficacy remains stable over time. Tschannen-Moran, Hoy, and Hoy (1998) found that little evidence exists as how teacher self-efficacy solidifies across a teaching career. It appears to be unclear as to whether teacher self-efficacy changes or stabilizes across a career. Brown and Gibson (1982) found that teachers at later stages in their career had lower teacher self-efficacy, while another study found that outstanding teachers had no differences in their teacher self-efficacy across career stages (Pigge & Marso, 1993). Housego (1992) found, through experience, a belief in one's personal power can increase, while a belief in the power of teaching may decrease. DeMesquita and Drake (1994) found in a study done on a Kentucky non-graded primary program, no significant difference between teacher self-efficacy between teachers at different stages in their careers.

Changing teacher self-efficacy. Teacher self-efficacy is a very important construct, related to numerous behaviors found in teachers as well as students. Even though high teacher self-efficacy produces higher measures of student achievement (Ashton & Webb, 1986), teacher beliefs appear to be quite stable and resistant to change (Brousseau, Book, & Byers, 1988). Tschannnen-Moran, Woolfolk Hoy, and Hoy (1998) contend that teacher self-efficacy is cyclical. Higher teacher self-efficacy leads to greater effort and persistence, which results in quality teaching performance, which leads to higher teacher self-efficacy. Lower teacher self-efficacy leads to less effort and persistence, which results in poor teaching performance, which leads right back to lower self-efficacy. Making a transition to the application of a new pedagogical approach is difficult because pre-existing beliefs are held onto even in the face of contradictory evidence (Kagan, 1992).

Bandura (1997) cautioned that positive changes in teacher self-efficacy come only through "compelling feedback that forcefully disrupts the preexisting disbelief in one's capabilities" (p.82). Studies done on reading comprehension have shown that the pre-existing beliefs that students bring to the text that they read causes gross misconceptions; however, students continue to use these pre-existing beliefs in their comprehension (Alvermann, Smith, & Readence, 1985; Anderson, Reynolds, Schallert. & Goetz, 1977). Teachers' self-efficacy also appears to not be affected by reading and applying the findings of educational research (Hall & Loucks, 1982). Empirical studies that have been done show that most teachers leave their university programs with the same set of beliefs that the teachers brought to the university. Instead of modifying their initial beliefs, students appear to become more comfortable with them (Feiman-Nemser & Buchmann, 1989; Tabachnick & Zeichner, 1984; Zeichner, 1989).

Teacher self-efficacy has been shown to change over time. DeMoulin (1993) noted a fluctuation in teacher self-efficacy levels from pre-service and novice teachers to experienced teachers presented with similar tasks. As teachers become more experienced, modifying teacher self-efficacy becomes more difficult. Even if teachers are exposed to new workshops or presented new teaching methods, there is a resistance to this change. Guskey (1986, 1989) confirmed that change is gradual and difficult after an intervention, and programs requiring change need to be accompanied by encouragement, support, and feedback in order to be most effective. Stein and Wang (1988) and Woolfolk and Hoy (1990) found that teacher expectations and teacher self-efficacy must be addressed before introducing new instructional material. Sparks (1988) found that when designing in-service programs, teacher self-efficacy and expectations should be considered. Teachers who have low teacher self-efficacy tend to defend their natural style of teaching and resist possible changes since they have lower expectations for themselves as well as their students. Teachers with high teacher self-efficacy are more willing to experiment with recommended practices and believe they could make improvements (Sparks, 1988). An approach that was shown to be effective by Sparks was the utilization of small instructional support groups where teachers could examine their own teaching in respect to research findings and then be able to discuss their concerns and successes within a safe environment. If these teachers tried a recommended strategy and found the strategy worked, they were more willing to experiment with other strategies. This environment allowed teachers to gain confidence, thus improving their teacher self-efficacy.

Sandholtz (1999) found that experiences that provide teachers with autonomy, choice, and active participation were critical to effective professional development. By allowing teachers to be actively involved in the process by participating and evaluating their own knowledge of teaching, teachers are able to capitalize in the use of critical thought and human agency (Bandura, 1997). Overall, teacher self-efficacy is malleable, but for change to occur in a teacher's self-efficacy well developed professional teacher development programs must be utilized and these programs must build upon critical thought and human agency.

In changing teacher self-efficacy, consideration must be given that teacher self-efficacy can be undermined, especially in teachers who have low teacher self-efficacy. Teachers with low teacher self-efficacy must not be placed in situations where failure is likely, since the result is a reduction in the teacher's participation, destabilization of the motivation, and lower self-efficacy Ross (1994). Tschannen-Moran, Woolfolk, Hoy, and Hoy (1998) identified implementations to increase teacher self-efficacy by providing opportunities for teacher collaborations, arranging for teachers to participate in decision making and sense of control, and raising the general health of the school climate.

Project Lead the Way

Project Lead the Way (PLTW) began in 1986 when Richard Blais, chairman of the technology department in the Shenendehowa Central School District in Upstate New York, began offering pre-engineering and digital electronics classes to encourage students to study engineering. Blais developed a rigorous, relevant curriculum and paired it with a dynamic, interactive learning environment. Based on the success of these classes, Blais partnered with Richard Liebich, whose family founded the Charitable Leadership Foundation (CLF), to establish PLTW. The first post-secondary PLTW partner was Rochester Institute of Technology, which became the program's first national affiliate and hosted the first professional development Summer Training Institute for teachers. The PLTW program was first introduced into 12 New York State high schools during the 1997-98 school year and was field tested the following year in three middle schools. Currently, there are over 400,000 students involved in the PLTW program in all 50 states of the United States, including Washington D.C. (PLTW, 2011).

PLTW's curriculum emphasizes critical thinking, creativity, innovation, and real-world problem solving. Students enrolled in a PLTW curriculum must also enroll in a sequence of college-preparatory mathematics and science courses. PLTW classes are hands-on, based in real-world experiences. PLTW sets the highest standards for rigorous classes that develop students' innovative, collaborative, cooperative, and problem-solving skills. Students have the opportunity to create, design and build projects, applying what they are learning in math and science to the real world challenges. Each course emphasizes hands-on, project-based activities that engage students on multiple levels, exposing them to subjects that they typically would not pursue, and providing them with a strong foundation for achieving their academic goals in any chosen field of study. The PLTW program establishes a proven path to college and career success in STEM related industries (PLTW, 2011). Students who took courses developed by PLTW scored significantly higher on science and mathematics in the NAEP than students in a random, stratified comparison group (Bottoms & Anthony, 2005; Bottoms & Uhn, 2007). PLTW students earn higher GPAs as freshmen in college and are studying engineering and technology in greater numbers that the national average, with a higher retention rate in college engineering, science, and related programs than non-PLTW students (PLTW, 2011).

The PLTW middle school program (grades 6-8), called Gateway to Technology (GTT), is a project based program that incorporates national standards in mathematics, science, and technology. Unlike the high school program, where students may select PLTW courses, GTT is designed to be offered to all students. There are six, nine-week, instructional units which introduce many of the fundamentals covered in the PLTW high school curricula. These units include: automation and robotics, design and modeling, energy and the environment, flight and space, magic of electrons, and science of technology (PLTW, 2011).

The high school curriculum contains eight courses that are grouped into foundation courses, specialization courses, and a capstone course. Students are encouraged to take three foundation courses and at least one specialization course as well to complete the sequence with the a capstone course. The three foundation courses include: Principle of Engineering, Introduction to Engineering Design, and Digital Electronics. The specialization courses consist of Computer Integrated Manufacturing, Civil Engineering and Architecture, Aerospace Engineering, and Biotechnical Engineering. The capstone course includes: Engineering Design and Development (PLTW, 2011).

PLTW classes are taught in school during the school day, and every PLTW instructor receives extensive training as well as ongoing support in the courses they teach. All teachers complete a two-week professional development course for every PLTW class that they teach. Since 1997, PLTW affiliates have trained nearly 15,000 teachers to teach their courses. The two week Core Training session is taught at over 40 PLTW-approved post-secondary affiliates around the country. A PLTW virtual academy provides ongoing professional development training, detailed materials for each lesson in every PLTW course, videos of PLTW master teachers teaching PLTW lessons, and collaboration tools; including forums for teachers to ask questions, update each other on changes, and to discuss PLTW lessons (PLTW, 2011).

In addition, PLTW encourages schools to develop relationships with leading corporations, philanthropic foundations, and prestigious colleges and universities. The efforts of school partners help ensure PLTW classrooms have the latest technology, materials, and equipment, and that PLTW students are learning the most up-to-date information found in such fields as information technology, engineering design, and alternative energy (PLTW, 2011).

Chapter III: Method

A quantitative approach was employed in this study to measure how factors influence the teacher self-efficacy of secondary engineering educators. A Web-based instrument was administrated to secondary engineering educators to obtain quantitative data using a demographic instrument and a self-efficacy instrument.

Participants

The population for this study consisted of 7,082 PLTW secondary engineering educators (including 145 Pilot Study participants and 6,937 other PLTW teacher participants in the full study) This population included both PLTW middle school teachers (teaching the Gateway to Technology" curriculum) and high school PLTW teachers (teaching the "Pathway to Engineering") Curriculum. Rather than sample this population, all members of the population were invited to participate in the study in order to maximize the number of respondents, and because electronic administration of the instrumentation via the Web made it relatively easy to invite the entire PLTW teacher population to participate. Of those PLTW teachers who responded to the study, 314 (27.38%) were female and 833 (72.62%) were male. Their mean age was 44.82 years (*SD* = 10.73) with a range of 22–73 years of age. The population had an average teaching experience of 14.37 years *(SD=9.36)* with a range of 1-45 years.

Research Design

Two quantitative instruments provided data used for an analysis of factors that influence PLTW teachers' self-efficacy based on Bandura's (1977, 1986, 1997) definition of self-efficacy. The quantitative approach was descriptive in nature in that variables were not manipulated. To explain the influence of self-efficacy, the measurement of self-efficacy must be designed based upon the participant's environment and the individual's progression within that environment (Bandura, 1997). Maurer and Andrews (2000) compared the reliability and validity of three formats of self-efficacy scale (traditional, Likert and general categorical). The results revealed that for assessing task specific level and strength of self-efficacy, traditional and Likert measures are useful.

Instrumentation

A demographic questionnaire (Appendix B) included questions related to: (a) gender; (b) age; (c) residence of PLTW teachers; (d) teaching experience; (e) school setting; (f) additional PLTW teachers within school; (g) teacher licensure process; (h) post-secondary degrees; (i) teaching endorsements; (j) post-secondary credit hours; (k) decision to teach the PLTW curriculum; (l) non-PLTW teaching experience; (m) PLTW grade levels taught; (n) PLTW teaching experience; (o) semesters teaching PLTW classes; (p) number of PLTW sections currently being taught; (q) PLTW certification; (r) hours of online support received; (s) hours of online support provided; (t) hours discussing PLTW issues; and (u) hours spent with PLTW partnership team. Additional factors/items intended for novice teachers included: (v) student teaching completed; (w) student teaching under a PLTW mentor/teacher; and (x) student teaching role (if any) in PLTW classes. These demographic variables emerged from the literature review. The questionnaire items were initially developed by the researcher with input from one STEM education expert. That version of the questionnaire was reviewed by two PLTW Directors of Assessment, the PLTW Director of Market Development and Relationships and by a panel of six STEM/engineering education content professionals to establish content validity. Content validity can vary across populations, and validity should be established for the population that will be sampled for the intended function (Nunnally & Bernstein, 1994; Suen, 1990). Since this instrument only established the demographic characteristics of the participants and the instrument did not measure a construct of interest, all effort was made to develop a demographic instrument that minimized interpretation biases. Applicable dimensions such as relevance, representativeness, specificity, and clarity can guide judgments about the content validity of the elements (Nunnally & Bernstein, 1994). Content validity was achieved by the consensus of the panel of content professionals in that the selected questions included in the demographic instrument established a specific set of engineering educator characteristics. Lissitz and Samuelsen (2007) gave weight to the recommendation from content experts as to the completeness of test specifications regarding content representativeness as sufficient evidence of content validity. In an effort to validate the content validity, face validity was addressed during the pilot study, where a minimum of twenty-four participants were asked for recommendations as to improvements that could be made to the demographic instrument to eliminate or revise ambiguous questions. Final content validity was defined as the panel of content professionals being in agreement that each question on the demographic instrument was relevant, representative, specific, and clearly defined (Nunnally & Bernstein, 1994).

The *Teachers' Self-Efficacy Belief System* (TEBS-S) instrument consisted of 31 items (Dellinger et al., 2008). Each of the 31 items used a 4-point Likert-type scale, with anchors at: (1) Weak Beliefs in my Capabilities; (2) Moderate Beliefs in my Capabilities; (3) Strong Beliefs in my Capabilities; and (4) Very Strong Beliefs in my Capabilities. The Cronbach alpha reliability of the TEBS-S instrument has ranged from 0.80 to 0.87 (Dellinger et al., 2008) (Appendix C). Dellinger et al., (2008) determined four moderately correlated factors that could be used with the instrument: (a) efficacy in accommodating individual differences; (b) efficacy in managing learning routines; (c) efficacy in maintaining a positive classroom climate; and (d) efficacy in monitoring feedback for learning.

Procedure: Pilot Study

With approval from Virginia Tech's Institutional Review Board, the researcher contacted the PLTW Director of Assessment and Evaluation and informed him the research proposal had been approved and that the pilot study should begin. The PLTW Director contacted initially 145 PLTW teachers (randomly selected from the PLTW e-mail database) via e-mail, asking if they would willingly participate in a teacher self-efficacy pilot study. The objective was to obtain a sample size between 24 and 36 participants. Johanson and Brooks (2010) found that 24-36 participants are a reasonable sample size for a pilot study. Beyond 36 participants, there is minimal change in the confidence interval. The purpose of the pilot study was to identify ambiguities and problems respondents encountered with the survey directions and item statements, and to obtain content validity. In addition to identifying problems, participants were asked to record the time required to complete the survey. Items that the participants identified as problematic were revised as appropriate. Using the results from the pilot study, a Cronbach alpha was computed on the four TEBS-S dimensions (efficacy in accommodating individual differences; efficacy in managing learning routines; efficacy in maintaining a positive classroom climate; and efficacy in monitoring feedback for learning). These Cronbach alpha values were compared to the TEBS-S Cronbach alpha values (Dellinger et al., 2008) (Appendix C) to validate internal consistency between questions. The results of the pilot study were used by the researcher to make any necessary modifications to Web-based survey prior to the actual study.

Procedure: Survey Administration

Once the pilot study was completed and revisions to the questionnaire were finalized, the researcher informed the PLTW Director of Assessment and Evaluation that the final study was to begin. The Director contacted each of the PLTW teachers via e-mail, asking if they would willingly participate in a teacher self-efficacy study (Appendix D). This e-mail informed prospective participants of the value of their participation, provided them with a link to the online survey, indicating that all responses were anonymous and optional. Pilot study participants were not invited to participate in this full study. Four days later, the PLTW Director of Assessment and Evaluation sent another e-mail (Appendix E) to all participants, encouraging non-respondents to complete the survey. This procedure was repeated four days later, and the survey was closed a week after the second "follow-up" e-mail.

Data Analysis

Research question 1. *What influence do selected demographic characteristics have on PLTW teachers' self-efficacy?*

Frequency distributions and percentages (FP) were computed for each of the following demographic variables: gender, age, residence, teaching experience, school setting, additional PLTW teachers, licensure process, post-secondary degrees, teaching endorsements, and post-secondary credit hours. (Appendix A).

Teacher self-efficacy means and standard deviations (MS) were computed for the four associated TEBS-S dimensions—Accommodating Individual Differences (AID), Managing Learning Routines (MLR), Maintaining a Positive Classroom Climate (CC), and Monitoring Feedback for Learning (MFL)—with regard to each demographic variable (gender, age, residence, teaching experience, school setting, additional PLTW teachers, licensure process, post-secondary degrees, teaching endorsements, and post-secondary credit hours). (Appendix A).

A one way analysis of variance (ANOVA) was computed on the demographic variables to determine which demographic variables, if any influenced PLTW teachers' self-efficacy.

The results from the data analysis determined what influence selected demographic characteristics had on PLTW teachers' self-efficacy.

Research question 2. *What influence do selected pre-PLTW teaching experiences have on PLTW teachers' self-efficacy?*

Frequency distributions and percentages (FP) were computed for each of the following variables: decision to teach PLTW curriculum, non-PLTW teaching experience, student teaching completed, student teaching under a PLTW mentor/teacher, and student teaching role (if any) in PLTW classes. (Appendix A).

Teacher self-efficacy means and standard deviations (MS) were computed for the four associated TEBS-S dimensions—Accommodating Individual Differences (AID), Managing Learning Routines (MLR), Maintaining a Positive Classroom Climate (CC), and Monitoring Feedback for Learning (MFL)—with regard to each demographic variable (decision to teach PLTW curriculum, non-PLTW teaching experience, student teaching completed, student teaching under a PLTW mentor/teacher, and student teaching role (if any) in PLTW classes). (Appendix A).

A one way analysis of variance (ANOVA) was computed on the demographic variables to determine which demographic variables, if any, influenced PLTW teachers' self-efficacy.

The results from the data analysis determined what influence selected pre-PLTW teaching experiences had on PLTW teachers' self-efficacy.

Research question 3. *What influence do selected PLTW teaching experiences have on PLTW teachers' self-efficacy?*

Frequency distributions and percentages (FP) were computed for each of the following variables: PLTW grade levels taught, PLTW teaching experience, number of semesters teaching PLTW classes, and sections of classes taught during 2010-2011. (Appendix A).

Teacher self-efficacy means and standard deviations (MS) were computed for the four associated TEBS-S dimensions—Accommodating Individual Differences (AID), Managing Learning Routines (MLR), Maintaining a Positive Classroom Climate (CC), and Monitoring Feedback for Learning (MFL)—with regard to each demographic variable (PLTW grade levels taught, PLTW teaching experience, number of semesters teaching PLTW classes, and sections of classes taught during 2010-2011). (Appendix A).

A one way analysis of variance (ANOVA) was conducted on the demographic variables to determine whether a significant difference existed between the self-efficacy means in order to determine whether the demographic variable influenced the PLTW teacher's self-efficacy.

The results from the data analysis determined what influence selected PLTW teaching experiences have on PLTW teachers' self-efficacy

Research question 4. *What influence do selected in-service professional development experiences have on PLTW teachers' self-efficacy?*

Frequency distributions and percentages (FP) were computed for each of the following demographic variables: PLTW certification, hours of online support per month, hours of online support provided per month, hours per month discussing PLTW issues, and hours spent with PLTW partnership team. (Appendix A).

Teacher self-efficacy means and standard deviations (MS) were computed for the four associated TEBS-S dimensions—Accommodating Individual Differences (AID), Managing Learning Routines (MLR), Maintaining a Positive Classroom Climate (CC), and Monitoring Feedback for Learning (MFL)—with regard to each demographic variable (PLTW certification, hours of online support per month, hours of online support provided per month, hours per month discussing PLTW issues, and hours spent with PLTW partnership team). (Appendix A).

A one way analysis of variance (ANOVA) was conducted on the demographic variables to determine whether a significant difference existed between the self-efficacy means in order to determine whether the demographic variable influenced the PLTW teacher's self-efficacy.

The results from the data analysis determined what influence selected in-service professional development experiences have on PLTW teachers' self-efficacy.

Chapter IV: Results[2]

Pilot Study

A pilot study was undertaken to identify ambiguities and problems participants encountered with the survey directions and item statements, and to establish content validity. The researcher invited 145 PLTW teachers (randomly selected from the PLTW database) to participate in the pilot study. From that group, 41 e-mails were returned as undeliverable, resulting in 104 potential participants. Possible reasons for the 41 non-respondents included: improper e-mail addresses, full inboxes, local system maintenance, and school e-mail filters. Of the 104 potential pilot study participants who were contacted via e-mail 33 opened the survey, and 30 PLTW teachers (29% of the potential participants) completed the pilot study survey.

Gender of participants. The frequency distribution of participants' gender is presented in Table H1. Male PLTW teachers comprised 76.67% (n = 23) of the sample population and female PLTW teachers represented 23.33% (n = 7).

Age of participants. The frequency distribution of participants' age is presented in Table H2. PLTW teachers' ages ranged from 23 to 70 with a mean age of 44.30 (*SD* = 12.73) for the sample population. The mean age for males was 45.57 (*SD* = 13.02) and 40.14 (*SD* = 11.63) for females.

Years of teaching experience. The frequency distribution of participants' total years of teaching experience is presented in Table H3. Of the 30 participants, 29 chose to provide this information. PLTW teachers' total years of teaching experience ranged from 1 to 35 with a mean experience level of 16.21 (*SD* = 10.54) for the sample population.

Post-secondary degrees completed. The frequency distribution of participants' post-secondary degrees completed is presented in Table H4. Of the 30 participants, 30 chose to provide this information. A total of 61 post-secondary degrees were awarded to the 30 participants. One participant had not completed a post-secondary degree, but was in the process of completing a degree in education.

Licensure process. The frequency distribution of participants' licensure process is presented in Table H5. Participants who were awarded a teaching license after earning a degree in an educational field comprised 86.7% (n = 26) of the sample population while participants who were awarded a teaching license without yet earning in an educational field comprised 13.3% of the sample population (n = 4).

[2] All tables identified in this chapter appear in Appendices H, I or J.

Chronbach alpha coefficients. Table H6 documents the internal consistency values (Cronbach alpha) of the Pilot Study compared to the Cronbach alpha coefficients for each of the four dimensions of the TEBS-S instrument (Dellinger et al., 2008) (Appendix C). The Pilot Study demonstrated an acceptable internal consistency for all four dimensions with higher internal consistency showing on 3 of the 4 dimensions. The lowest Cronbach's alpha coefficient was 0.862 (Accommodating Individual Differences), which was higher than the acceptable criterion for a developed instrument of 0.80 (Carmines & Zeller, 1979). A Cronbach alpha coefficient was also computed for each of the four teacher self-efficacy dimensions if one of the TEBS-S questions was deleted. Improvements in the Cronbach Alpha coefficients for each of four dimensions were found to be minimal. This information can be found in tables H7-H10.

Average time to complete pilot survey. The frequency distribution of participants' time required to complete the Pilot Study survey is presented in Table H11. The average time to complete the Pilot Study survey was 15.56 minutes ($SD = 5.01$) for the sample population. The mode was found to be 10 minutes (n = 7).

Pilot study findings. Within the Pilot Study instrument, participants were provided additional space to comment on the survey questions. One participant found that survey question #12 *List the number of post-secondary semester hours you have completed in each of the following disciplines. If you have been enrolled in a program that used quarter hours, please convert hours such that, 3 quarter hours = 2 semester hours* to be difficult to answer unless the participant had a transcript available. Survey question #14, *Select the percentage of time over your entire K-12 teaching career that you have taught the following school subjects (total of percentages must equal 100),* was not answered correctly on a consistent basis. Of the 30 respondents, 8 (27%) answered the question incorrectly so that their total percentage did not equal 100%.

Content Validity

A panel of nine experienced professionals in the field of K-12 Engineering Education was invited to assist in establishing the content validity of the survey. Eight of the nine experienced professionals were recommended by PLTW based upon their engineering education experience levels and their professional credentials within PLTW. The professional panel assessed: (1) Each survey item's relevance to the associated research question; and (2) the clarity of the wording of each survey item. Respondents were shown a research question (RQ), and were then asked to rate the degree of agreement regarding each RQ-related items' relevance to that research question using a four-point scale, ranging from 1 to 4, with 1 (Survey question is not relevant in addressing the research question) and 4 (Survey question is relevant in addressing the research question). They repeated that process for each of the RQs. Respondents were also asked to rate the degree of clarity of each survey item, using a four-point scale, ranging from 1 to 4, with 1 (Survey item is not clear) and 4 (Survey item is clear). An additional item-specific comment box was provided for each survey item. Of the nine experienced professionals asked to participate in this survey validation process, six chose to complete an on-line content validity survey using Survey Monkey.

Table I1 details the qualifications of the six experienced professionals. Five experienced professionals were active PLTW teachers with an average K-12 teaching experience of eighteen years. The sixth experienced professional was a Professor of Integrative STEM Education with approximately thirty-four years of post-secondary teaching experience.

Table I2 demonstrates the rating score for the 24 survey questions by the six experienced professionals regarding relevance to research questions. Of the 24 survey questions, 20 survey questions received a 3 or 4 rating, while one experienced professional rated 3 questions with a rating of 1.

Table I3 demonstrates the Content Validity Index (CVI) rating for each the 24 survey questions regarding *relevance* to the research questions. Of the 24 survey questions, 21 survey questions were highly relevant with a CVI of 1.00. Survey questions 4, 5, and 6 had lower CVI values than the other survey questions at 0.83. The mean I-CVI value was determined to be 0.97. Questions 4, 5, and 6 were retained in the survey since 5 out of 6 experienced professionals rated them as being highly relevant. Thus the content validity (relevance to research questions) was confirmed. Lissitz and Samuelsen (2007) gave weight to the recommendation from content experts as to the completeness of test specifications regarding content representativeness as sufficient evidence of content validity.

Table I4 demonstrates the rating score for the 24 survey questions by the six experienced professionals regarding *clarity*. Of the 24 survey questions, 24 survey questions received a 3 or 4 rating establishing that all survey questions were rated as being clear.

Table I5 demonstrates the CVI rating for each the 24 survey questions regarding *clarity*. Of the 24 survey questions, 23 survey questions were determined clear with a CVI of 1.00. Survey question 11 had a lower CVI value than other survey questions at 0.83. Question 11 was retained in the survey since 5 out of 6 experienced professionals rated the questions as being highly relevant. The mean I-CVI value was determined to be 0.99. Thus the content validity (clarity) was confirmed. Lissitz and Samuelsen (2007) gave weight to the recommendation from content experts as to the completeness of test specifications regarding content representativeness as sufficient evidence of content validity.

Modifications Resulting from Pilot Study and Content Validity

Even though the content validity indexes demonstrated that the demographic instrument was valid, the researcher chose to clarify two questions resulting from comments obtained from the pilot study participants and from the experienced professionals. These changes were reviewed with a Professor of Integrative STEM Education and consensus was reached. Table I6 details the changes that were made to the survey questions.

Study Results

The study results were obtained by having the PLTW Director of Assessment and Evaluation invite, 6937 PLTW teachers, via email, to participate in a teacher self-efficacy study. From the 6937 PLTW teacher/prospective participants contacted, 1609 chose to open the survey and 1157 returned useable responses (16.7% response rate) that met the following criteria: All questions on the TEBS-S instrument were completed and a minimum of 85% of the demographic questions were completed (20 out of 23 questions).

Chronbach alpha coefficients. Table J1 documents the internal consistency values (Cronbach alpha) of the study compared to the Cronbach alpha coefficient for each of the four dimensions of the TEBS-S instrument (Dellinger et al., 2008) (Appendix C). The study demonstrated acceptable internal consistency for all four dimensions in measuring teacher self-efficacy with higher internal consistency showing on 4 of the 4 dimensions. The lowest Cronbach's alpha coefficient was 0.818, which achieved an acceptable criterion for a developed instrument of 0.80 (Carmines & Zeller, 1979). A Cronbach alpha coefficient was also computed for each of the four teacher self-efficacy dimensions if one of the TEBS-S questions was deleted. Improvements in the Cronbach alpha coefficients for each of four dimensions were found to be minimal. This information can be found in tables J2-J5.

Research Question 1. *What influence do selected demographic characteristics have on PLTW teachers' self-efficacy?*

Gender of PLTW teachers. The frequency distribution of the PLTW teachers' gender is presented in Table J6. Male PLTW teachers comprised 72.62% (n = 833) of the sample population and females represented 27.38% (n = 314). The teacher self-efficacy means based on the gender of the PLTW participants is presented in Table J7. The teacher self-efficacy of male PLTW teachers was slightly higher than females on all five teacher self-efficacy dimensions. Male and female PLTW teachers had higher teacher self-efficacy regarding maintaining a positive classroom climate while male and female PLTW teachers had lower teacher self-efficacy regarding accommodating individual differences. Table J8 presents the ANOVA results comparing the means (overall teacher self-efficacy) based upon the gender of the PLTW teachers. The results show that there was no significant difference in the means (overall teacher self-efficacy) based on the gender of the PLTW teachers.

These findings appear to be consistent with existing research in that males tend to have higher teacher self-efficacy than females in areas related to mathematics, science and technology (Meece, 1991; Pajares & Miller, 1994; Wigfield, Eccles, & Pintrich, 1996); however, Eisenberg, Martin, & Fabes (1996) found that differences in self-efficacy in mathematics, science and technology has diminished or has disappeared. Most researchers have also reported no gender differences in the strength of the relationship between the sources and self-efficacy (Matsui, Matsui, & Ohnishi, 1990; Britner & Pajares, 2006; Lent, Lopez, & Bieschke, 1991; Lent, Lopez, Brown, & Gore, 1996; Pajares, Johnson, & Usher, 2007).

Age of PLTW teachers. The frequency distribution of PLTW teachers' age is presented in Table J9. The mean age of the PLTW teachers was 44.82 years (*SD*=10.73) with the largest percentages (17.86%) occurring in the age range of 50-54 years and (17.07%) occurring in the age range of 45-49 years. The teacher self-efficacy means based on the age of the PLTW teachers is presented in Table J10. The highest overall PLTW teacher self-efficacy occurred in the age range of 60-64 years. Table J11 presents the ANOVA results comparing the means (overall teacher self-efficacy) based upon the age of the PLTW teachers. The results show that there was no significant difference in the teacher self-efficacy means based on the age of the PLTW teachers.

These findings are consistent with existing research in that teacher self-efficacy means tend to be lower among the novice teachers than among career teachers (Tschannen-Moran & Woolfolk Hoy, 2007). Differences in teacher self-efficacy based on age may be attributed to the fact that older teachers will typically have more teaching experience. Bates and Khasawneh, (2007) found that past mastery experience contributed to higher self-efficacy.

Residence of PLTW teachers. The frequency distribution of the PLTW teachers' residence is presented in Table J12. The largest number of PLTW teachers resided in New York (89) followed by Texas (86), Wisconsin (84), and Indian (82). The five states with the highest overall teacher self-efficacy means are presented in Table J13 and include New Jersey (3.53), Arizona (3.52), Florida (3.51), New York (3.50) and Maryland (3.49). The states with the lowest overall teacher self-efficacy means are presented in Table J14 and include Louisiana (3.12), Kentucky (3.12), Utah (3.13), Michigan (3.13) and Oregon (3.15). Note: states presented in these tables had a minimum of 10 PLTW teachers. Teacher self-efficacy means for all states can be found in table J15.

An ANOVA was not conducted based on Residence of PLTW Teachers due to the concern for *effect size* since PLTW teacher populations varied considerably across all 50 states. Existing research measuring the affect that locality has on teacher self-efficacy could not be found; however, an interesting finding by the researcher is 3 out of the 5 states that had higher teacher self-efficacy were states that were ranked above average regarding the Science and Engineering Readiness Index (SERI). The SERI index measures the progress in K-12 physical science and engineering education (White & Cottel, 2011). Research does demonstrate that ethnicity can have an influence on self-efficacy (Stevens, Olivárez, & Hamman, 2006).

Teaching experience of PLTW teachers. The frequency distribution of PLTW teachers' teaching experience is presented in Table J16. The mean teaching experience of PLTW teachers was 14.37 years (*SD*=9.36) with the largest percentages (25.63%) occurring in the range of 5-9 years and (19.07%) occurring in the age range of 10-14 years. Overall, 72.09% of PLTW teachers had between 1 and 19 years of teaching experience. Teacher self-efficacy means based on teaching experience are presented in Table J17. All five dimensions of teacher self-efficacy show an increasing trend as teaching experience increases with a stabilization point occurring after 20 years of experience. Tables J18-J22 presents the ANOVA results comparing the means based upon the age of the PLTW teachers and the different dimensions of the TEBS-S instrument. The results show that there was a significant difference in the teacher self-efficacy means based on teaching experience of PLTW teachers across all dimensions of the TEBS-S instrument. In Figure 2, a trend line was presented demonstrating the relationship between overall teacher self-efficacy and teaching experience.

Teaching experience appears to be a major factor in influencing the teacher self-efficacy of PLTW teachers. These findings are consistent with the literature review in that mastery experience heavily influences teacher self-efficacy (Bandura, 1977). Unlike with any other source, correlations between mastery experience and self-efficacy are significant in every investigation (Usher & Pajares, 2008). Woolfolk (2007) found that experienced teachers develop higher teacher self-efficacy in that they have experienced real success with students.

Figure 2. Overall Teacher Self-efficacy Based on Teaching

School setting of PLTW teachers. The frequency distribution of PLTW teachers' school setting is presented in Table J23. Public schools comprised 96.27% (n = 1109) of the sample population. Teacher self-efficacy means based on school setting are shown in Table J24. The average mean for public schools was 3.34 compared to private non-parochial having an average mean of 3.47; however, only 2 private non-parochial were used in determining this teacher self-efficacy means. Table J25 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on school setting of PLTW teachers. The results show that there was no significant difference in the teacher self-efficacy based on school setting of PLTW teachers.

Additional PLTW teachers. The frequency distribution of additional PLTW teachers employed at the PLTW teacher's current school is presented in Table J26. Schools having between 0 and 3 additional PLTW teachers comprised 88.36% (n = 1016) of the sample population and schools having 1 additional PLTW teacher was the highest comprising 28.51% (n = 329) of the sample population. Teacher self-efficacy means based on additional PLTW teachers are shown in Table J27. Overall teacher self-efficacy means varied little when compared to the number of additional PLTW teachers. Comparing schools that had between 0 and 4 additional PLTW teachers, the means (overall teacher self-efficacy) varied between 3.29 and 3.36. Table J28 presents the ANOVA results comparing the means (overall teacher self-efficacy) and additional PLTW teachers. The results show that there was no significant difference between the means with additional PLTW teachers.

These findings were unexpected in that additional PLTW teachers who are employed in the school should influence the PLTW teacher's self-efficacy if the PLTW teacher's department had high collective efficacy. Trust in colleagues (Hoy & Kupersmith, 1985; Hoy & Sabo, 1998) has been found to be positively related to collective teacher efficacy. A teacher may be highly inefficacious, but that teacher might perform differently depending on whether the majority of teacher colleagues in a school share strong perceptions of collective efficacy. The effect of an individual teacher's efficaciousness may be either be attenuated or enhanced depending on the level of collective efficacy in a school (Goddard, Hoy, & Woolfolk Hoy, 2000)

PLTW teachers' licensure process. The frequency distribution of PLTW teachers' licensure process is presented in Table J29. Licensed PLTW teachers comprised of 97.48% (n = 1120) of the sample population. PLTW teachers (having a teaching license after earning a degree in an educational field) comprised of 75.72% (n = 870) of the sample population while PLTW teachers (having a teaching license after not earning a degree in an educational field) comprised of 21.76% (n = 250) of the sample population. Teacher self-efficacy means based upon the licensure process are shown in Table J30. Overall teacher self-efficacy means were the highest with licensed PLTW teachers having a mean (overall teacher self-efficacy) of 3.34 and non-licensed PLTW teachers (3.04-3.06). No difference existed between the means (overall teacher self-efficacy) between PLTW teachers who were licensed after earning a degree in an educational field and PLTW teachers who were licensed after not earning a degree in an educational field. Tables J31-J35 presents the ANOVA results comparing teacher self-efficacy means based upon PLTW teachers' licensure process and the different dimensions of the TEBS-S instrument. The results show that there was a significant difference in the teacher self-efficacy means based on the PLTW teacher licensure process. Further research is needed to explore what sources or factors associated with the licensure process leads to higher teacher self-efficacy.

PLTW teachers' post-secondary degrees completed. The frequency distribution of PLTW teachers' post-secondary degrees completed is presented in Table J36. PLTW teachers having post-secondary degrees in Technology Education comprised 28.55% (n = 608) of the sample population. Of the 1134 PLTW respondents, 2130 degrees were completed, which included 1303 bachelor degrees, 807 master's degrees, and 20 doctorate degrees. Of the 807 master's degrees, Technology Education comprised 24.04% (n = 194) and Education comprised 34.57% (n = 279). Teacher self-efficacy means based upon the post-secondary bachelor degrees awarded are shown in Table J37. PLTW teachers who earned a bachelor's degree in Science (non-education) had the highest mean (overall teacher self-efficacy) of 3.41 while the lowest mean (overall teacher self-efficacy) came from PLTW teachers who earned a bachelor's degree in Engineering having a mean of 3.28. Table J38 presents the ANOVA results comparing the means (overall teacher self-efficacy) based upon post-secondary bachelor degrees awarded. The results show that there was no significant difference in the teacher self-efficacy means based on post-secondary bachelor degrees awarded.

Teacher self-efficacy means based upon the post-secondary master's degrees awarded are shown in Table J39. PLTW teachers who earned a master's degree in Mathematics (non-education) had the highest mean (overall teacher self-efficacy) of 3.61 while the lowest mean (overall teacher self-efficacy) came from PLTW teachers who earned a master's degree in Engineering Education having a mean of 3.18. Table J40 presents the ANOVA results comparing the means (overall teacher self-efficacy) based upon post-secondary master degrees awarded. The results show that there was a significant difference in the teacher self-efficacy means based on post-secondary master degrees awarded.

Teacher self-efficacy means based upon the post-secondary bachelor degrees in combination with a master's in Education are shown in Table J41. PLTW teachers who had a bachelor's degree in Science Education with a master's in Education had the highest mean (overall teacher self-efficacy) of 3.54 while the lowest mean (overall teacher self-efficacy) came from PLTW teachers who had a bachelor's degree in Mathematics (non-education) with a master's in Education having a mean of 3.19. Table J42 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on post-secondary bachelor degrees in combination with a master's in Education. The results show that there was no significant difference in the teacher self-efficacy means based on post-secondary bachelor degrees in combination with a master's in Education.

Teacher self-efficacy means based upon the post-secondary bachelor degrees in combination with a master's in Technology Education are shown in Table J43 PLTW teachers who had a bachelor's degree in Mathematics (non-education) with a master's in Technology Education had the highest mean (overall teacher self-efficacy) of 3.66 while the lowest mean (overall teacher self-efficacy) came from PLTW teachers who had a bachelor's degree in Engineering with a master's in Technology Education having a mean of 3.17. Table J44 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on post-secondary bachelor degrees in combination with a master's in Technology Education. The results show that there was no significant difference in the teacher self-efficacy means based on post-secondary bachelor degrees in combination with a master's in Technology Education.

PLTW teachers' post-secondary degrees in progress. The frequency distribution of PLTW teachers' post-secondary degrees in progress is presented in Table J45. PLTW teachers working toward a post-secondary degree comprised of 21.87% (n = 248) of the sample population. Of the 248 PLTW respondents, 27.83% (n = 69) PLTW respondents were working toward a post-secondary degree in education, while 25.81% (n = 64) PLTW teachers were working toward a post-secondary degree in Technology Education.

PLTW teaching endorsement by grade level. The frequency distribution of PLTW teachers' teaching endorsement by grade level is presented in Table J46 Technology Education represented 44.50% (n = 1485), Math Education 16.60% (n =554), Other 15.55% (n = 518), Science Education 15.22% (n = 508) and STEM Education 8.12% (n = 271) of all teaching endorsements. Teacher self-efficacy means based upon teaching endorsement by grade level are shown in Table J47. The K-5 teaching endorsement with the highest mean (overall teacher self-efficacy) was STEM Education with a mean of 3.51. The 6-8 teaching endorsement with the highest mean (overall teacher self-efficacy) was STEM Education with a mean of 3.43. The 9-12 teaching endorsement with the highest mean (overall teacher self-efficacy) was Technology Education with a mean of 3.37. However, differences in teacher self-efficacy means based upon PLTW teaching endorsement across the same grade level were not significant.

These findings consistent with Ashton and Webb (1986) who found that teachers working in a school with a middle-school structure and philosophy tended to have higher self-efficacy than those in a higher grade structure.

Post-secondary hours completed. The frequency distribution of participants' post-secondary hours completed is presented in Table J48. Table J49 presents the teacher self-efficacy means compared to completed credit hours in Mathematics. PLTW teachers (n = 93) who had completed between 13-18 hours of credit hours in Mathematics had the highest mean (overall teacher self-efficacy) of 3.45. PLTW teachers (n = 431) who had not completed any credit hours in Mathematics had the lowest mean (overall teacher self-efficacy) of 3.20. Table J50 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Mathematics. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Mathematics.

Table J51 presents the teacher self-efficacy means compared to completed credit hours in Mathematics Education. PLTW teachers (n = 7) who had completed between 22-24 hours of credit hours in Mathematics Education had the highest mean (overall teacher self-efficacy) of 3.48. PLTW teachers (n = 33) who had completed 10-12 credit hours in Mathematics Education had the lowest mean (overall teacher self-efficacy) of 3.18. Table J52 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Mathematics Education. The results show there was no significant difference in the means based on completed post-secondary credit hours in Mathematics Education.

Table J53 presents the teacher self-efficacy means compared to post-secondary completed credit hours in Science. PLTW teachers (n = 125) who had completed between 10-15 hours of credit hours in Science had the highest mean (overall teacher self-efficacy) of 3.46. PLTW teachers (n = 820) who had not completed any credit hours in Science had the lowest mean (overall teacher self-efficacy) of 3.24. Table J54 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Science. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Science.

Table J55 presents the teacher self-efficacy means compared to post-secondary completed credit hours in Science Education. PLTW teachers (n = 46) who had completed more than 24 hours of credit hours in Science Education had the highest mean (overall teacher self-efficacy) of 3.50. PLTW teachers (n = 37) who had completed 10-12 credit hours in Science Education had the lowest mean (overall teacher self-efficacy) of 3.11. Table J56 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Science Education. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Science Education.

Table J57 presents the teacher self-efficacy means compared to completed post-secondary credit hours in Technology. PLTW teachers (n = 55) who had completed 1-3 credit hours in Technology had the highest mean (overall teacher self-efficacy) of 3.44. Teachers (n = 501) who had not completed any post-secondary credit hours in Technology had the lowest mean (overall teacher self-efficacy) of 3.18. Table J58 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Technology. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Technology.

Table J59 presents teacher self-efficacy means compared to completed post-secondary credit hours in Technology Education. PLTW teachers (n = 52) who had completed 10-12 credit hours in Technology Education had the highest mean (overall teacher self-efficacy) of 3.47. PLTW teachers (n = 26) who had completed 16-18 credit hours in Technology Education had the lowest mean (overall teacher self-efficacy) of 3.20. Table J60 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Technology Education. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Technology Education.

Table J61 presents teacher self-efficacy means (overall teacher self-efficacy) compared to completed post-secondary credit hours in Engineering. PLTW teachers (n = 68) who had completed 10-12 credit hours in Engineering had the highest mean (overall teacher self-efficacy) of 3.44. PLTW teachers (n = 13) who had completed 19-21 credit hours in Engineering had the lowest mean (overall teacher self-efficacy) of 3.17. Table J62 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Engineering. The results show there was no significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Engineering.

Table J63 presents the teacher self-efficacy means compared to the completed post-secondary credit hours in Vocational T&I Education. PLTW teachers (n = 14) who had completed 22-24 credit hours in Vocational T&I Education had the highest mean (overall teacher self-efficacy) of 3.51. PLTW teachers (n = 8) who had completed 19-21 credit hours in vocational T&I Education had the lowest mean (overall teacher self-efficacy) of 2.97. Table J64 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Vocational T&I Education. The results show that there was a significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Vocational T&I Education.

Table J65 presents the teacher self-efficacy means compared to completed post-secondary credit hours in Curriculum and Instruction. PLTW teachers (n = 212) who had completed more than 24 credit hours in Curriculum and Instruction had the highest mean (overall teacher self-efficacy) of 3.46. PLTW teachers (n = 56) who had completed 7-9 credit hours in Curriculum and Instruction had the lowest mean (overall teacher self-efficacy) of 3.19. Table J66 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on completed post-secondary credit hours in Curriculum and Instruction. The results show that there is a significant difference in the teacher self-efficacy means based on completed post-secondary credit hours in Curriculum and Instruction. These findings are consistent with existing research that shows that teacher self-efficacy is linked to general academic achievement (Chemers et al., 2001 Pintrich & DeGroot, 1990; Silver, Smith, & Greene, 2001).

Research Question 2. *What influence do selected pre-PLTW teaching experiences have on PLTW teachers' self-efficacy?*

Decision to teach PLTW curriculum. The frequency distribution of PLTW teachers' decision for teaching a PLTW curriculum (based upon decision maker) is presented in Table J67. PLTW teachers who were personally responsible for making the decision to teach a PLTW curriculum represented 36.43% (n = 420) of the PLTW teachers. PLTW teachers who were persuaded by their principal or assistant principal to teach a PLTW curriculum represented 28.71% (n = 331) of the PLTW teachers. Table J68 presents the teacher self-efficacy means based on the decision to teach a PLTW curriculum (based upon decision maker). Findings demonstrate minimal variation between the means. Table J69 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the decision to teach a PLTW curriculum (based upon decision maker). The results show there is no significant difference in the teacher self-efficacy means based on decision to teach a PLTW curriculum.

Non-PLTW course teaching experience. The frequency distribution of the PLTW teachers' non PLTW course teaching experience is presented in Table J70. PLTW teachers who had taught Mathematics represented 42.57% (n = 490) of the PLTW teachers. PLTW teachers who had taught Science represented 38.75% (n = 446) of the PLTW teachers. PLTW teachers who had taught Technology Education represented 66.11% (n = 761) of the PLTW teachers. PLTW teachers who had taught Engineering (other than PLTW) represented 28.76% (n = 331) of the PLTW teachers. PLTW teachers who had taught vocational T&I represented 36.32% (n = 418) of the PLTW teachers.

Table J71 presents the teacher self-efficacy means based on the years that PLTW teachers have taught math classes. PLTW teachers who had taught math classes for 26-30 years (n = 10) had the highest mean of 3.51 while PLTW teachers who had taught math classes for 31-35 years (n = 3) had the lowest mean of 2.98. Table J72 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught math classes. The results show that there was a significant difference in the teacher self-efficacy means based on the years that PLTW teachers have taught math classes.

Table J73 presents the teacher self-efficacy means based on the years that PLTW teachers have taught science classes. PLTW teachers who had taught Science classes for 16-20 years (n = 33) had the highest mean of 3.50 while PLTW teachers who had taught Science classes for 36-40 years (n = 3) had the lowest mean of 2.87. Table J74 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught Science classes. The results show that there was no significant difference in the teacher self-efficacy means based on the years that PLTW teachers have taught Science classes.

Table J75 presents the teacher self-efficacy means based on the years that PLTW teachers have taught Technology Education classes. PLTW teachers who had taught Technology Education classes for over 40 years (n = 3) had the highest mean of 3.54 while PLTW teachers who had taught Technology Education for 26-30 years (n = 40) had the lowest mean of 3.27. Table J76 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught Technology Education classes. The results show that there was a significant difference in the teacher self-efficacy means based on the years that PLTW teachers have taught Technology Education classes.

Table J77 presents the teacher self-efficacy means based on the years that PLTW teachers have taught Engineering (other than PLTW) classes. PLTW teachers who had taught Engineering Education classes for 11-15 years (n = 17) had the highest mean of 3.45 while PLTW teachers who had taught Engineering (other than PLTW) for 16-20 years (n = 6) had the lowest mean of 3.05. Table J78 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught Engineering (other than PLTW) classes. The results show that there is no significant difference in the teacher self-efficacy means based on the years that PLTW teachers have taught Engineering (other than PLTW) classes.

Table J79 presents the teacher self-efficacy means based on the years that PLTW teachers have taught Vocational T&I Education classes. PLTW teachers who had taught Vocational T&I Education classes for 31-35 years (n = 9) had the highest mean of 3.45 while PLTW teachers who had taught Vocational T&I Education classes for more than 40 years (n = 1) had the lowest mean of 3.19. Table J80 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught Vocational T&I Education classes. The results show that there was a significant difference in the teacher self-efficacy means based on the years that PLTW teachers have taught Vocational T&I Education classes.

These findings are consistent with the findings of Tsui (1995) who noted that "years of teaching experience in a teaching setting is an overriding factor in molding one's feelings of teaching efficacy" (p.372). These findings are not surprising in that mastery and vicarious experiences have been identified as the major sources of efficacy beliefs by Bandura (1997).

Completion of Student Teaching. The frequency distribution based on the completion of student teaching (1-4 years of experience) is presented in Table J81. PLTW teachers who had student taught prior to becoming a PLTW teacher represented 62.32% (n = 86) of the sample population while PLTW teachers who had not student taught prior to becoming a PLTW teacher represented 37.68% (n = 52) of the sample population. Table J82 presents the teacher self-efficacy means based on completion of student teaching. The results demonstrate that teacher self-efficacy means of PLTW teachers were slightly higher among teachers who had completed student teaching; however, there is no significant difference.

These findings are consistent with existing research in that student teaching does not lead to higher self-efficacy and student teaching can actually be detrimental to the development of teacher self-efficacy in that the teacher experiences as a sudden, total immersion, sink-swim approach to teaching (Hoy & Spero, 2005).

Student Teaching under a PLTW Mentor. The frequency distribution based on the PLTW teacher (1-4 years' experience) student teaching under a PLTW mentor is presented in Table J83. PLTW teachers who had student taught under a PLTW mentor represented 13.77% (n = 19) of the sample population while PLTW teachers who had not student taught under a PLTW mentor represented 86.23% (n = 119) of the sample population. Table J84 presents the teacher self-efficacy means based on student teaching under a PLTW mentor. The results demonstrate that self-efficacy means of PLTW teachers were slightly higher among teachers who had student taught under a PLTW mentor. Table J85 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on student teaching under a PLTW mentor. The results show there was no significant difference in the self-efficacy means based on student teaching under a PLTW mentor.

Research question 3. *What influence do selected PLTW teaching experiences have on PLTW teachers' self-efficacy?*

Grade level of PLTW courses. The frequency distribution of PLTW teachers' grade level in which they currently teach is presented in Table J86. PLTW teachers who taught grades 9-12 represented 83.93% (n = 951) of the participants. Table J87 presents the teacher self-efficacy means based on the grade levels that the PLTW teachers currently teach. PLTW teachers who taught at the middle school level (grades 6-8) had means (overall teacher self-efficacy) of 3.42, 3.39, and 3.38 respectively while PLTW teachers who taught at the high school level (grades 9, 10, 11 and 12) had means (overall teacher self-efficacy) of 3.32, 3.32, 3.33, and 3.33 respectively. The results demonstrate that there was no significant difference between the teacher self-efficacy means and the grade level of the PLTW courses.
These findings consistent with Ashton and Webb (1986) who found that teachers working in a school with a middle-school structure and philosophy tended to have higher self-efficacy than those in a higher grade structure.

PLTW teaching experience. The frequency distribution of the PLTW teachers' PLTW teaching experience is presented in Table J88. PLTW teachers who had taught PLTW classes for 1-5 years represented 65.35% (n = 751) of the PLTW teachers. Table J89 presents the means (overall teacher self-efficacy) based on the years that PLTW teachers have taught PLTW classes. PLTW teachers who had taught PLTW classes for 11-15 years (n = 59) had the highest mean of 3.57. PLTW teachers who had taught PLTW classes for 16-20 years (n = 3) had the lowest mean of 3.23. Table J90 presents the ANOVA results comparing the means (overall teacher self-efficacy) based on PLTW teaching experience. The results show that there was a significant difference in the teacher self-efficacy means based on PLTW teaching experience.

Number of semesters teaching PLTW classes. The frequency distribution based on the number of semesters that the PLTW teachers had taught PLTW courses is presented in Table J91. The Intro to Engineering Design was the dominant PLTW class taught with 532 PLTW teachers having taught this class including 208 PLTW teachers having taught this class 4-6 semesters. Table J92 presents the teacher self-efficacy means based on semesters that the PLTW teachers had taught PLTW courses. The results demonstrate that teacher self-efficacy means tend to increase the longer the PLTW courses are taught. Tables J93-J101 present the ANOVA results comparing the means (overall teacher self-efficacy) based on the semesters that the PLTW course had been taught. The results show that there was a significant difference in the teacher self-efficacy means based on the semesters the following classes has been taught: Gateway to Technology, Intro to Engineering Design, Digital Electronics, and Computer Integrated Manufacturing.

Sections of classes taught during 2010 fall semester. The frequency distribution based on the number of sections of classes taught during the 2010 fall semester is presented in Table J102. The Intro to Engineering Design was the dominant PLTW class taught with 535 sections being taught during the fall semester. Table J103 presents the teacher self-efficacy means based on sections of classes taught during the 2010 fall semester. The results demonstrate that teacher self-efficacy means tend to increase when PLTW teachers are teaching more than one section of a specific class. Tables J104-J120 present the ANOVA results comparing the means (overall teacher self-efficacy) based on the sections of classes that were taught during 2010 fall semester. The results show that there was a significant difference in the teacher self-efficacy means based on the sections the following classes had been taught: Gateway to Technology, Intro to Engineering Design, Digital Electronics, and Engineering Design and Development.

Sections of classes taught during 2011 spring semester. The frequency distribution based on the number of sections of classes taught during the 2011 spring semester is presented in Table J121. The Intro to Engineering Design was the dominant PLTW class taught with 499 sections being taught during the spring semester. Table J122 presents the teacher self-efficacy means based on sections of classes taught during the 2011 spring semester. The results demonstrate that teacher self-efficacy means tend to increase when PLTW teachers are teaching more than one section of a specific class. Tables J123-J126 present the ANOVA results (based on classes that showed a significance during the fall 2010 semester) comparing the means based on the sections of classes taught during the 2011 spring semester. The results showed that there was a significant difference in the teacher self-efficacy means based on the number of sections that the Gateway to Technology class had been taught.

Research question 4. *What influence do selected in-service professional development experiences have on PLTW teachers' self-efficacy??*

PLTW certification process. The frequency distribution of the PLTW teachers' certification is presented in Table J127. The two week summer certification process was the dominant process of certifying PLTW teachers. The PLTW class, Intro to Engineering Design, had the largest number of certifications (n = 668) followed by the class, Principles of Engineering (n = 507). The class, Biotechnical Engineering had the fewest number of certifications (n = 28). Table J128 presents the teacher self-efficacy means based on the PLTW certification process. PLTW teachers who had received PLTW certification through a post-secondary process had higher means (overall teacher self-efficacy) in every PLTW course compared to the two-week certification process.

An ANOVA was not conducted based on the PLTW certification process due to the concern for *effect size* since the number of PLTW teachers who are certified through a two-week certification process is considerably larger than the number of PLTW teachers who are certified through a post-secondary process. However, these findings support the finding by Mundry (2007), that professional development that occurs over time is likely to be more coherent and support active learning than "one shot" workshops. Professional development activities that are of adequate duration are more likely to have other desirable features such as coherence, content focus, and active learning (Garet, et al., 1999). Further research is needed to explore whether specific factors associated with the certification process leads to higher teacher self-efficacy.

Hours of PLTW on-line support received per month. The frequency distribution based on the number of hours of PLTW on-line support received per month is presented in Table J129. PLTW teachers receiving 0 hours of support represented 32.17% (n = 368) of the sample population while PLTW teachers receiving 1 hour of support represented 30.42% (n = 348) of the sample population. Table J130 presents teacher self-efficacy means based on the number of hours of PLTW on-line support received per month. The results demonstrate that teacher self-efficacy means of PLTW teachers based upon the number of hours of PLTW on-line support received per month tend to increase when PLTW teachers receive some monthly support.

Hours of PLTW on-line support provided per month. The frequency distribution based on the number of hours of PLTW on-line support provided per month is presented in Table J131. PLTW teachers providing 0 hours of support represented 70.77% (n = 804) of the sample population while PLTW teachers providing 1 hour of support represented 19.19% (n = 218) of the sample population. Table J132 presents the teacher self-efficacy means based on number of hours of PLTW on-line support provided per month. The results demonstrate that teacher self-efficacy means of PLTW teachers based upon the number of hours of PLTW on-line support provided per month tend to increase when PLTW teachers receive some monthly support.

An ANOVA was not conducted based on the hours of PLTW on-line support provided per month due to the concern for *effect size* since the number of hours provided per month was heavily skewed toward 0 to 1 hours of on-line support.

Hours per month discussing PLTW issues. The frequency distribution based on the number of hours per month that a PLTW teacher discusses PLTW issues is presented in Table J133. PLTW teachers who spent 0 hours discussing PLTW issues represented 50.84% (n = 578) of the sample population while PLTW teachers who spent 1 hour of support represented 24.36% (n = 277) of the sample population. Table J134 presents the teacher self-efficacy means based on the number of hours per month that a PLTW teacher discusses PLTW issues. The results demonstrate that teacher self-efficacy means of PLTW teachers based upon the number of hours per month that a PLTW teacher discusses PLTW issues, tend to increase when PLTW teachers spend some time each month discussing PLTW issues.

An ANOVA was not conducted based on the hours per month discussing PLTW issues due to the concern for *effect size* since the hours per month discussing PLTW issues was heavily skewed toward 0 to 2 hours of monthly discussion.

Hours per year spent with PLTW partnership team. The frequency distribution based on the number of hours per year that a PLTW teacher spends with their PLTW partnership team is presented in Table J135. PLTW teachers spending 0 hours per year with their PLTW partnership team represented 26.03% (n = 298) of the sample population while PLTW spending 2 hours per year with their PLTW partnership team represented 14.15% (n = 162) of the sample population. PLTW teachers spending more than 10 hours per year with their PLTW partnership team represented 11.70% (n = 134) of the sample population. Table J136 presents the teacher self-efficacy means based on number of hours per year that a PLTW teacher spends with their PLTW partnership team. The results demonstrate that teacher self-efficacy means of PLTW teachers based upon the number of hours per year that a PLTW teacher spends with their PLTW partnership tend to increase when PLTW teachers spend some time with their PLTW partnership team.

Chapter V: Summary, Discussion, and Implications

.

Summary of the Study

The purpose of this study was to examine selected experiences/factors among PLTW secondary engineering educators that might influence teacher self-efficacy. A demographic instrument developed by the researcher was used in conjunction with the *Teachers' Self-Efficacy Belief System* (TEBS-S) instrument (Dellinger et al., 2008). Approximately 7,000 PLTW teachers were invited to participate in this study; 1,157 PLTW teachers completed both instruments and a comparative analysis was performed to measure the influence that selected factors had on the teacher self-efficacy of these PLTW teachers.

Factors and Experiences Found to be Significant (Organized by Research Question)

The following factors and experiences, which were found to be statistically significant, should be considered by those who are preparing, hiring, and/or providing professional development for secondary engineering educators.

Research Q 1: *What influence do selected demographic characteristics have on PLTW teachers' self-efficacy?*

- Residence
- Teaching Experience
- PLTW Teachers' Licensure Process
- Post-Secondary Master's Degrees
- Post-Secondary Hours Completed

Research Q2: *What influence do selected pre-PLTW teaching experiences have on PLTW teachers' self-efficacy?*

- Non-PLTW Teaching Experience

Research Q3: *What influence do selected PLTW teaching experiences have on PLTW teachers' self-efficacy?*

- PLTW teaching experience
- Number of Semesters Teaching PLTW Classes
- Sections of Classes Taught During 2010-2011

Research Q4: *What influence do selected in-service professional development experiences have on PLTW teacher' self-efficacy?*

- PLTW Certification Process
- Hours of PLTW on-line Support Provided per Month
- Hours per Month that a PLTW Teacher Discusses PLTW Issues

Discussion and Implications

Because this study was conducted with the population of nearly 7000 Project Lead the Way teachers, implementing the best-known secondary engineering curriculum in the U.S, the implications of this study should be of interest to those hiring or preparing secondary engineering educators. This would include those: 1) preparing science teachers for the engineering curriculum outlined in the new *K-12 Science Education Framework* (NRC, 2011); 2) preparing teachers for the framework outlined in *2014 NAEP Technology and Engineering Literacy Assessment and Item Specifications* (NAGB, 2010); and 3) preparing secondary K-12 teachers such as *Project Lead the Way* and *Engineering by Design* teachers.

The new *K-12 Science Education Framework* (NRC, 2011) identifies the key scientific ideas and practices all students should learn by the end of high school. The framework serves as the foundation for forthcoming K-12 science education standards, to replace the *National Science Education Standards* (NRC, 1996). This new framework calls for additional emphasis on engineering and engineering design. With this emphasis, teachers will be required to help their students develop an understanding of engineering concepts. Teacher preparation and professional development programs will be required to provide effective methods where teachers can deepen their own conceptual understanding of engineering.

The *2014 NAEP Technology and Engineering Literacy Assessment and Item Specifications* (NAGB, 2010) established a framework for developing students skills and abilities leading to technology and engineering literacy. The process of engineering design includes defining problems in terms of criteria and constraints; researching and generating ideas; choosing between alternatives; making drawings, models, and prototypes; optimizing, testing, evaluating the design, and redesigning if needed; and, eventually, communicating the results. The demands and requirements to teach engineering in a K-12 classroom are very different from other content areas and selecting potential candidates with little or limited engineering experience is a difficult task (Custer, Erekson, Cunningham, Hailey, & Householder, 2007). Professional development of new and existing teachers will be necessary and important to the task of educating students for technological and engineering literacy.

As secondary K-12 engineering programs such as *Project Lead the Way* and *Engineering by Design* continue to expand, additional teachers will be required to teach K-12 engineering content. The process of selecting competent teachers is a difficult process, which may be informed by knowledge of characteristics and factors that lead to effective K-12 engineering teaching. Also, understanding how additional professional development activities and professional support systems can increase the effectiveness of K-12 engineering teachers is necessary for the long term success of K-12 engineering.

Given the aforementioned issues and frameworks the findings of this study have implications with respect to: the process of selecting secondary engineering educators; determining course loads for secondary engineering educators; and the professional development of secondary engineering educators.

Implications for selecting secondary engineering educators. With Engineering Education emerging in the K-12 classroom and with legislation being introduced that promotes increased emphasis on Engineering Education, selecting teachers to fill the role of an engineering educator is a difficult process. The findings from this research address specific characteristics that should be considered in selecting secondary engineering educators. The research indicates that STEM content endorsement is not factor when choosing efficacious secondary engineering educators. Secondary engineering educators from a wide range of disciplines should be considered in the selection process. Teaching experience appears to be the major factor in influencing the teacher self-efficacy of secondary engineering educators. Selecting teachers who have a minimum of five years of teaching experience leads to a more efficacious teacher as they make the transition to a secondary engineering educator. Teachers who gain secondary engineering teaching experience also tend to become more efficacious teachers. Regarding post-secondary educational backgrounds, differences in teacher self-efficacy did exist among the types and level of the post-secondary degrees. A teacher with a master's in Mathematics (non-education) had the highest mean (overall teacher self-efficacy), while a teacher with a master's in Engineering Education had the lowest teacher self-efficacy. The findings also indicated that teachers that had completed more than 24 hours in Curriculum and Instruction had higher teacher self-efficacy.

Implications for determining course load for secondary engineering educators. The findings from this research suggest that secondary engineering educators are more efficacious teachers the longer they teach introductory engineering classes as well as the number of times they teach these classes each semester. Higher teacher self-efficacy appears to be found in secondary engineering teachers who teach introductory engineering classes several times each semester across several years. Requiring a teacher to teach a variety of classes over a semester might lead to lower teacher self-efficacy. Administrators might use this information in determining the course load for their faculty to assure that their engineering educators have the opportunity to become more specialized in the engineering classes they teach. This approach correlates with Bandura's mastery experience concept. Bandura (1977) determined that mastery experiences influence teacher self-efficacy the most in that "they provide the most authentic evidence of whether one can muster whatever it takes to succeed" (Bandura, 1997, p. 80).

Implications for professional development of secondary engineering educators. The findings of this study suggest professional development activities influence the teacher self-efficacy of secondary engineering educators. One of the most important findings was that a post-secondary certification process was more effective in raising teacher self-efficacy than a two-week certification process. However, the number of teachers who were certified by a post-secondary process was small compared to the two-week certification process and additional research should be conducted to validate this finding. This finding implies that short-term professional training programs that certify a teacher to teach an engineering curriculum should be reviewed to assure adequate time is allocated where teachers can practice what was learned. Bandura (1977) advocated strategies such as modeling, verbal persuasion, and successful experiences in the improvement of efficacy beliefs. A certification process must be thoughtfully and effectively developed in order to allow teachers to transfer the knowledge they gain to their classrooms. Teachers who already have strong teacher self-efficacy should be able to affirm their efficacy through a certification process while teachers with lower teacher self-efficacy should leave a certification process equipped with new ideas and concepts to implement in their classrooms.

Another professional development implication is that secondary engineering educators should have the opportunity to actively interact with other secondary engineering educators. Findings from this research indicate that teacher self-efficacy is positively influenced when a secondary engineering educator is actively involved in providing support and discussing issues. Administrators and instructional support personnel should develop and promote activities that help facilitate interaction among secondary engineering educators.

Recommendations for Further Research

Several recommendations for future research in this area can be suggested. These recommendations may be considered as an extension to this study with the potential to further advance discovery in this area. These include the following:

Residence of secondary engineering educators. Considerable differences were found in the levels of teacher self-efficacy based upon the residency (state in which the PLTW resided) of the PLTW teacher. Additional research needs to be done in this area to develop an understanding as to what characteristics are unique in specific states where teacher self-efficacy is high and low. Understanding these characteristics will help in developing local and state policies that will enhance teacher self-efficacy.

Professional development of secondary engineering educators. Additional research is needed to determine whether secondary educators who are certified to teach secondary engineering courses through a post-secondary program over an extended period of time have higher teacher self-efficacy than secondary educators who are certified to teach secondary engineering courses through a short term certification process. Equivalent group sizes should be employed in investigating this factor in order to address *effect size*. Qualitative research would also be beneficial in this area to allow secondary engineering educators to offer further insight into this and other issues that the data in this study suggest might warrant further investigation. For example, qualitative input regarding specific aspects of pre- and in-service teacher preparation/professional development programs would help to identify specific strengths and weaknesses among those programs, which would be helpful to those developing future programs of that sort.

Teacher licensure process for secondary engineering educators. Because differences between means (overall teacher self-efficacy) of non-licensed teachers and licensed teacher were found to be significant, additional research would be useful using a larger sample size of non-licensed secondary engineering teachers to validate the findings of this study. Since the findings of this study also found that the means (overall self-efficacy) between a licensed PLTW teacher with a degree in an educational field and a licensed PLTW teacher with a degree in a non-educational field to be almost identical, additional research should be conducted to see if these finding are consistent across content areas and to validate the implication that an alternative teacher licensure process does not diminish teacher self-efficacy.

Longitudinal study of secondary engineering educators. A longitudinal study of secondary engineering educators as they transition from being a classroom teacher to a secondary engineering educator would be helpful. A mixed method research design conducted over the first five years of PLTW teaching might provide further understanding of the factors that influence the changes in teacher self-efficacy during those critical years.

References

Allinder, R. (1994). The relationship between efficacy and the instructional practices of special education teachers and consultants. *Teacher Education and Special Education, 17*, 86–95.

Alvermann, D.E., Smith, L.C., Readence, J. E. (1985). Prior knowledge activation and the comprehension of compatible and incompatible text. *Reading Research Quarterly, 20*, 420-436.

Anderson, R., Greene, *M*., & Loewen, P. (1988). Relationships among teachers' and students' thinking skills, sense of efficacy, and student achievement. *Alberta Journal of Educational Research*, *34*(2), 148-165.

Anderson, R. C, Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1977). Framework for comprehending discourse. *American Educational Research Journal, 14,* 367-381.

Armor, D., Conroy-Oseguera, P., Cox, *M*., King, *N*., McDonnell, L., Pascal, A., Pauly, E., & Zellman, G. (1976). *Analysis of the School Preferred reading programs in selected Los Angeles minority schools,* Report: R-2007-LAUSD. Santa Monica, CA: Rand Corporation.

Ashton, P. T. (1984). Teacher Efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education, 35*(5), 28-32.

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement.* New York: Longman.

Astin, H. S., & Sax, L. J. (1996). *Developing scientific talent in undergraduate women*. In C. Davis, A. B. Ginorio, C. S. Hollenshead, B. B. Lazarus, P. *M*. Rayman, & Associates (Eds.), The equity education: Fostering the advancement of women in the sciences, mathematics, and engineering (pp. 96-121). San Francisco: Jossey-Bass Publishers.

Aud, S., & Fox, *M*. A. (July, 2010). *Status and trends in the education of racial and ethnic groups.* The National Center for Education Statistics, U. S. Department of Education. Retrieved from http://nces.ed.gov/pubs2010/2010015.pdf.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist, 44*(9), 1175-1184.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*, 117-148.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman and Company.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26.

Bandura, A. (2004). Social cognitive theory of posttraumatic recovery: The role of perceived self-efficacy. *Behavior Research and Therapy, 42*, 1129-1148.

Bandura, A., & Cervone, D. (1983). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *Journal of Personality and Social Psychology, 45*, 1017-1028.

Barfield, V., & Burlingame, *M.* (1974). The pupil control ideology of teachers in selected schools. *The Journal of Experimental Education, 42(4),* 6-11.

Bates, R., & Khasawneh, S. (2007). Self-efficacy and college students' perceptions and use of online learning systems. *Computers in Human Behavior, 23*, 175-191.

Bender, W. *N.* (1995). *Learning Disabilities: Characteristics, identification, and teaching strategies.* (2nd Ed.). Needham Heights, Mass: Allyn & Bacon.

Benz, C. R., Bradley, L., Alderman, *M*.K., & Flowers, *M*.A. (1992). Personal teaching efficacy: developmental relationships in education. *Journal of Educational Research, 85,* 274-285.

Berman, P., McLaughlin, *M*., Bass, G., Pauly, E., & Zellman, G. (1977). *Federal programs supporting educational change: Vol. VII. Factors affecting implementation and continuation* (Rep. No. R-1589/7-HEW). Santa Monica, CA: RAND. (ERIC Document Reproduction Service No. 140 432).

Bohning, G., Hale, L., & Chowning, F. (1999). Change-of-career preservice elementary teachers: Their concerns about teaching science. *Education, 120*(1), 143-148.

Bottoms, G., & Anthony, K. (2005). *Project lead the way: A pre-engineering curriculum that works*. Atlanta, GA: Southern Regional Educational Board. Retrieved from http://scholar.lib.vt.eduejournals/JTE/v18n1/pdfprogers.pdf

Bottoms, G., & Uhn, J. (2007). *Project lead the way works: A new type of career and technical program.* Southern Educational Review Board. Retrieved from http://scholar.lib.vt.eduejournals/JTE/v18n1/pdfprogers.pdf

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal for Research in Science Teaching*, *43*(5), 485–499.

Brousseau, B. A., Book, C., & Byers, J. L. (1988). Teacher's beliefs and cultures of teaching. *Journal of Teacher Education, 39*(6), 33-39.

Brown, I., Jr., & Inouye, D.K. (1978). Learned helplessness through modeling: The role of perceived similarity in competence. *Journal of Personality and Social Psychology, 36,* 900-908.

Brown, R. & Gibson, S. (1982, April). *Teacher's sense of efficacy: Changes due to experience.* Paper presented at the annual meeting of the California Educational Research Association, Sacramento, CA.

Bursal, *M*., & Paznokas, L. (2006). Mathematics anxiety and preservice elementary teachers' confidence to teach mathematics and science. *School Science and Mathematics, 106*(4), 173-180.

Cantrell, P., Young, S., & Moore, A. (2003). Factors affecting science teaching efficacy of preservice elementary teachers. *Journal of Science Teacher Education, 14*(3), 177-192.

Carmines, E. G. & Zeller, R. A. (1979). *Reliability and validity assessment.* Beverly Hills, CA: SAGE publications.

Chemers, *M. M*., Hu, L., & Garcia, B. F. (2001). Academic self-efficacy and first-year college student performance and adjustment. *Journal of Educational Psychology, 93(1),* 55-64.

Collins, J. L. (1982). *Self-efficacy and ability in achievement behavior*. Paper presented at the annual meeting of the American Educational Research Association, New York.

Cousins, J., & Walker, C. (1995, June). *Personal teacher efficacy as a predictor of teachers' attitudes toward applied educational research*. Paper presented at the annual meeting of the Canadian Association for the Study of Educational Administration, Montreal, QC.

Couper, *M*. P. (2000). Web surveys: A review of issues and approaches. *Public Opinion Quarterly, 64*, 464-494.

Custer, R.L., Erekson, T.L., Cunningham, C., Hailey, C., & Householder, D. (2007). *Professional development for engineering and technology: A national symposium*, Dallas, Texas. Retrieved from www.conferences.ilstu.edu/NSA/homepage.html.

Darling-Hammond, L. (2003). Wanted: A national teacher supply policy for education: The right way to meet the highly qualified teacher. *Education Policy Analysis Archives*, *11*(33), 16-19.

Daugherty, M.K. (2006, July). Problem-based learning for K-12 engineering. *Proceedings of the 9th International Conference on Engineering Education,* San Juan, PR, 23- 28.

De Laat, J. & Watters, J. (1995). Science teaching self-efficacy in a primary school: A case study. *Research in Science Education*, *25*(4), 453-464.

Dellinger, A.B., Bobbett, J.J., Oliver, D.F., & Ellett, C.D. (2008). Measuring teacher's self-efficacy beliefs: Development and use of the TEBS-Self. *Teaching and Teacher Education, 24,* 751-766.

DeMesquita, P. B., & Drake, J. C. (1994). Educational reform and the self-efficacy beliefs of teachers implementing non-graded primary school programs. *Teaching and Teacher Education, 10*(3), 291–302.

DeMoulin, D. F. (1993). Efficacy and educational effectiveness. In J. R. Hoyle & D. M. Estes (Eds.), *NCPEA: In a new voice,* (pp. 155-167). Lancaster, PA: Technomic.

Denham, C.H. & Michael, J.J. (1981). Teacher sense of efficacy: A definition of the construct and a model for further research. *Educational Research Quarterly, 6*(1), 39-61.

Desouza, J. M. S., Boone, W. J., & Yilmaz, O. (2004). A study of the science teaching self-efficacy and outcome expectancy beliefs of teachers in India. *Science Education, 88*, 837-854.

Doyle, W. (1986). Classroom organization and management. In M. Wittrock (Ed.), *Handbook of research on teaching,* (3rd ed., pp. 392-431). New York: Macmillan.

Earley, P.C. & Lituchy, T.R. (1991). Determining goal and efficacy effects: A test of three models. *Journal of Applied Psychology, 76*(1), 81-98.

Eisenberg, N., Martin, C. L., & Fabes, R. A. (1996). Gender development and gender effects. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology,* (pp. 358-396). New York: Macmillan.

Enochs, L., & Riggs, I. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale. *School Science and Mathematics*, *90*, 694-706.

Feiman-Nemser, S., and Buchmann, M. (1989). Describing teacher education: A framework and illustrative findings from a longitudinal study of six students. *Elementary School Journal*, *89*, 365-377.

Findley, M. J. & Cooper, H. M. (1983). Locus of control and academic achievement: A literature review. *Journal of Personality and Social Psychology, 64*, 419-427.

Fives, H. (2005). *At the crossroads of teacher knowledge and teacher efficacy: A multimethod approach using cluster and case analysis.* Paper presented at the Annual Meeting of the American Educational Research Association 2005, Montreal, CA.

Fives, H. & Alexander, P.A. (2004). *Modeling teachers' efficacy, knowledge, and pedagogical beliefs.* Paper presented at the Annual Meeting of the American Psychological Association Annual Meeting, 2004, Honolulu: HI.

Garet, *M*. S., Birman, B. F., Porter, A. C., Desimone, L., Herman, R., & Yoon, K. S. (1999). *Designing effective professional development: Lessons from the Eisenhower program.* Washington, DC: US Department of Education.

Ghaith, G., & Yaghi, H. (1997). Relationships among experience, teacher efficacy, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education, 13*(4), 451-458.

Gibson, S., & Dembo, *M*. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76,* 569-582.

Gist, *M*. (1987). Self-efficacy: Implications for organizational behavior and human resource management. *Academy of Management Review, 12*(3), 472-485.

Gist, *M*., & Mitchell (1992). Self-efficacy: a theoretical analysis of its determinants and malleability. *Academy of Management Review, 17*(2), 183-211.

Glenn Commission. (2000). B*efore it's too late: A report to the national commission on mathematics and science teaching for the 21st century*. Retrieved from http://www.ed.gov/americacounts/glenn/toc.html.

Goddard, R. D., Hoy, W. K., & Woolfolk Hoy, A.E. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *American Educational Research Journal, 37*(2), 479-507.

Grossman, P. L., Wilson, S. *M*., & Shulman, L. S. (1989). Teachers of substances: Subject matter knowledge for teaching. In *M*. C. Reynolds (Ed.), *Knowledge base for the beginning teacher,* (pp. 23-36) New York: Pergamon.

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher*, *15*(5), 5-12.

Guskey, T.R. (1988). Teacher efficacy, self-concept, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education, 4*(1), 63-69.

Guskey, T. R. (1989). Attitude and perceptual change in teachers. *International Journal of Educational Research*, *13*, 439-453.

Hall, G. E., & Loucks, S. F. (1982). Bridging the gap: Policy research rooted in practice. In A. Lieberman & *M*. W. McLaughlin (Eds.), *Policy making in education.* (81st Yearbook of the National Society for the Study of Education, Part I, pp. 133-158). Chicago: University of Chicago Press.

Henson, R.K. (2001, January). *Teacher self-efficacy: Substantive implications and measurement dilemmas.* Paper presented at the annual meeting of the Educational Research Exchange, Texas A&*M* University, College Station, Texas.

Housego, B. (1992). Monitoring student teachers' feelings of preparedness to teach, personal teaching efficacy and teaching efficacy in a new secondary teacher education program. *Alberta Journal of Educational Research*, *38*(1), 49-64.

Hoy, W.K., and Kupersmith, W.J. (1985). The meaning and measure of faculty trust. *Educational and Psychological Research*, *5(*1), 1-10.

Hoy, W. K., & Rees, R. (1977). The bureaucratic socialization of student teachers. *Journal of Teacher Education, 28,* 23-26.

Hoy, A. W., & Spero, R. B. (2005). Changes in teacher efficacy during the early years of teaching: A comparison of four measures. *Teaching and Teacher Education, 21*(4), 343-356

Hoy, W. K. & Sabo, D.J. (1998). *Quality middle schools: Open and healthy.* Thousand Oaks, CA: Corwin Press, Inc.

Hoy, W. K., Sweetland, S.R., & Smith, P.A. (February 2002). Toward an organizational model of achievement in high schools: The significance of collective efficacy. *Educational Administration Quarterly, 38*(1), 77-93.

Hoy, W. K., & Woolfolk, A. E. (1989, March). *Socialization of student teachers.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

H.R.4709. (2010). *Engineering education for innovation act.* Bill introduced to the United States Congress. Retrieved from http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi? dbname= 111_cong_bills&docid=f:h4709ih.txt.pdf

Huinker, D., & Madison, S. K. (1997). Preparing efficacious elementary teachers in science and mathematics: The influence of methods courses. *Journal of Science Teacher Education, 8*(2), 107-126.

ITEA. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

ITEEA. (2011). *Engineering by design*. Reston, VA: Author.

Johanson, G. A., & Brooks, G. P. (2010). Initial scale development: Sample size for pilot studies. *Educational and Psychological Measurement*, *70*(3), 394-400.

Jones, J. W. (1989). Personality and epistemology: Cognitive social learning theory as a philosophy of science. *Zygon, 24*(1), 23-38.

Jones, E. & Nimmo, J. (1999). Collaborative, conflict, and change: Thoughts on education as provocation. *Young Children, 54*(1), 5-10.

Kagan, D. *M*. (1992). Implications of research on teacher belief. *Educational Psychologist, 27*(1), 65-90.

Kaiser, D. L. (1975). Internal-external control and causal attributions of own and others' performance. *Psychological Reports, 37,* 423-426.

Katehi, L., Pearson, G., & Feder, *M*. (2009). The status and nature of K-12 engineering education in the United States. *K-12 Engineering Education*, *Fall*, 5-10.

Kelley, T. R., Brenner, D. C., & Pieper J.T. (2010*).* Two approaches to engineering design: Observations in stem education. *Journal of Stem Teacher Education, 47*(2), 5-40.

Kennedy, H. L. (1996). Science learning: A self-efficacy study in higher education. (Doctoral dissertation, University of Southern California, 1996). *Dissertation Abstracts International, 57*(7A), 2856.

Knobloch, *N*. A., & Whittington, *M*. S. (2002). Novice teachers' perceptions of support, teacher preparation quality and student teacher experience related to teacher efficacy. *Journal of Vocational Educational Research, 27*(3), 331-341.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology*, *38*, 424–430.

Lent, R. W., Lopez, F. G., Brown, S. D., & Gore, P. A. (1996). Latent structure of the sources of mathematics self-efficacy. *Journal of Vocational Behavior*, *49*, 292–308.

Lissitz, R. W., & Samuelsen, K. (2007). A suggested change in terminology and emphasis regarding validity and education. *Educational Researcher, 36,* 437–448.

Lumpe, A. T., Haney, J. J., & Czerniak, C. *M*. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching, 37*(3), 275-292.

Mamlin, *N*., Harris, K. R., Case, L. P. (2001). A methodological analysis of research on locus of control and learning disabilities: Rethinking a common assumption. *Journal of Special Education*, *34,* 214-225.

Marsh, H. W. (1990). Influences of internal and external frames of reference on the formation of math and English self-concepts. *Journal of Educational Psychology, 82,* 107-116.

Marsh, H. W., Barnes, J., Cairns, L., & Tidman, *M*. (1984). Self-description questionnaire: Age and sex effects in the structure and level of self-concept for preadolescent children. *Journal of Educational Psychology*, *76*, 940-956.

Marsh, H. W., Byrne, B. *M*., & Shavelson, R. J. (1988). A multifaceted academic self-concept: Its hierarchical structure and its relation to academic achievement. *Journal of Educational Psychology, 80*, 366-380.

Marsh, H. W. and O'Neill, R. (1984). Self-description questionnaire III: The construct validity of multidimensional self-concept ratings by late-adolescents'. *Journal of Educational Measurement, 21*, 153-174.

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior*, *37*, 223–238.

Maurer, T., & Andrews, K. (2000). Traditional, likert, and simplified measures of self-efficacy. *Educational and Psychological Measurement*, *60*, 965-973.

Maurer, T. J., & Palmer, J.K. (1999). Management development intentions following feedback: role of perceived outcomes, social pressures, and control. *Journal of Management Development*, *18*, 733-751.

Maurer, T. J., & Taralli, B. (1994). Perceived environment, perceived outcome, and person variables in relationship to voluntary development activity by employee. *Journal of Applied Psychology, 79*, 3-14.

McVearry, R. D. (2003, April). High-tech high schools build bridges to college. *Engineering Times,* Alexandria, VA: National Society of Professional Engineers.

Midgley, C., Feldlaufer, H., & Eccles, J. (1989). Change in teacher efficacy and student self- and task-related beliefs in mathematics during the transition to junior high school. *Journal of Educational Psychology*, *81*, 247–258.

Meece, J. L. (1991). The classroom context and students' motivational goals. In *M*. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement, 7*, 261-285. Greenwich, CT: JAI Press.

Meijer, C. J. W., & Foster, S. F. (1988). The effect of teacher self-efficacy on referral change. *Journal of Special Education*, *22*, 378-385.

Miller, R. B., Greene, B. A., Montalvo, G. P., Ravindran, B., & Nichols, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. *Contemporary Educational Psychology*, *21*, 388-422.

Milner, H. R., and Woolfolk Hoy, A. (2003). Teacher self-efficacy and retaining talented teachers: A case study of an African American teacher. *Teaching and Teacher Education, 19*, 263–276.

Minke, K. *M*., Bear, G. G., Deemer, S. A., & Griffin, S. *M*. (1996). Teachers' experiences with inclusive classrooms: Implications for special education reform. *Journal of Special Education, 30,* 152-186.

Moore, W., & Esselman, *M*. (1992). *Teacher efficacy, power, school climate and achievement: A desegregating district's experience.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Muijs, R.D., & Reynolds, D. (2001). School effectiveness and teacher effectiveness: Some preliminary findings from the evaluation of the mathematics enhancement programme. *School Effectiveness and School Improvement*, *11*(3), 273-303.

Mulholland, J., & Wallace, J. (2001). Teacher induction and elementary science teaching: Enhancing self-efficacy. *Teaching and Teacher Education, 17*, 243-261.

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38*, 30-38.

Mundry, S. (2007). *Professional development in science education: What works*? Presented at the National Symposium on Professional Development for Engineering and Technology Education, Dallas, Texas, February 11–13, 2007. Retrieved from www.conferences.ilstu.edu/NSA/homepage.html.

NAE & NRC (National Academy of Engineering and National Research Council). (2009). *Engineering in K-12 education: Understanding the status and improving prospects*. In L. Katehi, G. Pearson, & *M*. Feder (Eds.) National Academy Science.

NAGB (National Assessment Governing Board). (2010). *2014 national assessment of educational progress (NAEP) technology and engineering literacy framework and test item specifications.* Washington, DC: Author. Retrieved from http://www.edgateway.net/cs/naepsci/print/docs/470.

NAS, NAE, & IOM (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine). (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, D.C.: The National Academies Press.

Noe, R., & Wilk, S. (1993). Investigation of factors that influence employees' participation in development activities. *Journal of Applied Psychology, 78.* 291-302.

NRC (National Research Council). (2011). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* National Committee for Science Education Standards and Assessment. Washington, DC: National Academy Press. Retrieved from http://www.nap.edu/catalog.php?record_id=13165

Nunnally, J. C. & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*, 543-578.

Pajares, F. (1997). Current directions in self-efficacy research. In *M*. Maehr & P. R. Pintrich (Eds.), *Advances in Motivation and Achievement, 10,* (Greenwich, CT: JAI Press); 1-49.

Pajares, F. (2000, January). *Schooling in America: Myths, mixed messages, and good intentions*. Lecture delivered at the Great Teachers Lecture Series, Cannon Chapel, Emory University, Atlanta.

Pajares, F. (2002). *Overview of social cognitive theory and of self-efficacy.* Retrieved from http://www.emory.edu/EDUCATION/mfp/ eff.html

Pajares, F., Johnson, *M*. J., & Usher, E. L. (2007). Sources of writing self-efficacy beliefs of elementary, middle, and high school students. *Research in the Teaching of English*, *42*, 104–120.

Pajares, F., & Miller, *M*. D. (1994). The role of self-efficacy and self-concept beliefs in mathematical problem-solving: A path analysis. *Journal of Educational Psychology, 86*, 193-203.

Pajares, F. & Schunk, D. H. (2001). *Self-beliefs and school success: Self-efficacy, self-concept, and school achievement.* Retrieved from http://www.des.emory.edu/mfp/PajaresSchunk 2001.html.

Payne, R. S. (1994). The relationship between teachers' beliefs and sense of efficacy and their significance to urban LSES minority students. *Journal of Negro Education, 63,* 181-196.

Pigge, F.L. & Marso, R.*N*. (1993). A longitudinal assessment of the affective impact of preservice training on prospective teachers. *Journal of Experimental Education, 58*(4), 283-289.

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, *82*(1), 33-40.

Pintrich, P. R., & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In *M*. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement*: *Goals and self-regulatory processes*, (Vol.7, pp. 371-402). Greenwich, CT: JAI Press.

Pintrich, P.R. & Schunk, D. H. (1996). *Motivation in education: Theory, research, and applications.* Englewood Cliffs, NJ: Merrill/Prentice Hall.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications.* (2nd ed.). Upper Saddle, NJ: Prentice-Hall, Inc.

Plourde, L. A. (2002). Elementary science education: The influence of student teaching–where it all begins. *Education, 123*(2), 253-259.

PLTW (Project Lead the Way). (2011). Retrieved from http://www.pltw.org.

Prieto, L., & Altmaier E. (1994). The relationship of prior training and previous teaching experience to self-efficacy among graduate teaching assistants. *Research in Higher Education, 35*, 481-497

Ramey-Gassert, L., Shroyer, *M*. G., & Staver, J. R. (1996). A qualitative study of factors influencing science teaching self-efficacy of elementary level teachers. *Science Education, 80*, 283-315.

Raudenbush, S.W., Rowan, B., & Cheong, Y.F. (1992). Contextual effects on the self-perceived efficacy of high school teachers. *Sociology of Education, 65,* 150-167.

Rice, D. C., & Roychoudhury, A. (2003). Preparing more confident preservice elementary science teachers: One elementary science methods teacher's self-study. *Journal of Science Teacher Education, 14*(2), 97-126.

Ross, J. A. (1992). Teacher efficacy and the effect of coaching on student achievement. *Canadian Journal of Education, 17*(1), 51-65.

Ross, J. A. (1994). The impact of in-service to promote cooperative learning on the stability of teacher efficacy. *Teaching and Teacher Education, 10*(4), 381-394.

Ross, J. A. (1998). The antecedents and consequences of teacher efficacy. *Advances in Research on Teaching, 7*, 49-73.

Ross, J.A., & Cousins, J.B. (1993). Enhancing secondary school students' acquisition of correlational reasoning skills. *Research in Science & Technological Education, 11,* 191-205.

Rotter, J. B. (1954). *Social learning and clinical psychology*. New York: Prentice Hall.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, 80*, 1-28.

Sadker, *M*., & Sadker, D. (1995). *Failing at fairness: How our schools cheat girls.* New York: Touchstone Press.

Sadri, G., & Robertson, I. (1993). Self-efficacy and work-related behavior: a review and meta-analysis. *Applied Psychology: An International Review, 42*, 139-152.

Sandholtz, J. H. (1999). *A companion of direct and indirect professional development activities*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Sarason, S. (1990). *The predictable failure of educational reform.* San Francisco: Jossey-Bass.

Schoon, K. J., & Boone, W. J. (1998). Self-efficacy and alternative conceptions of science of elementary teachers. *Science Education, 82*, 553-568.

Schunk, D. H. (1981). Modeling and attributional effects on children achievement: A self-efficacy analysis. *Journal of Educational Psychology, 73*, 93-105.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology, 81*, 201-209.

Sciutto, *M*. J., Terjesen, *M*. D., & Bender Frank, A. S. (2000). Teachers' knowledge and misperceptions of Attention-Deficit/Hyperactivity Disorder. *Psychology in the Schools, 37,* 115-122.

Seymour, E., & Hewitt, *N*. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview.

Shields, C. J. (2007). Barriers to the implementation of project lead the way as perceived by Indiana high school principals. *Journal of Industrial Teacher Education, 44(*3), Retrieved from http://scholar.lib.vt.edu/ejournals/JITE/v44n3/shields.html.

Silver, B. B., Smith, E. V., Jr., & Greene, B. A. (2001). A study strategies self-efficacy instrument for use with community college students. *Educational and Psychological Measurement, 61*(5), 849-865.

Smist, J. *M*., Archambault, F. X., & Owen, S. V. (1997, April). *Gender and ethnic differences in attitude toward science and science self-efficacy among high school students.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Soodak, L. C., & Podell, D. *M*. (1997). Efficacy and experience: Perceptions of efficacy among preservice teachers. *Journal of Research and Development in Education, 30*, 214-221.

Sparks, G.*M*. (1988). Teachers' attitudes toward change and subsequent improvements in classroom teaching. *Journal of Educational Psychology, 80,* 111-117.

Stein, S., McRobbie, C., & Ginns, I. (2002) Implications of missed opportunities for learning and assessment in design and technology education. *Teaching and Teacher Education, 15*, 35-49.

Stein, *M*.K. & Wang, *M*. C. (1988). Teacher development and school improvement: The process of teacher change. *Teaching and Teacher Education, 4,* 171-187.

Stevens, T., Olivárez, A., Jr., & Hamman, D. (2006). The role of cognition, motivation, and emotion in explaining the mathematics achievement gap between Hispanic and White students. *Hispanic Journal of Behavior Sciences*, *28,* 161–186

Suen, H. K. (1990). *Principles of test theories.* Hillsdale, NJ: Erlbaum.

Tabachnick, B. R., & Zeichner, K. (1984). The impact of the student teaching experience on the development of teacher perspectives. *Journal of Teacher Education*, *35*, 28-36.

Tapping America's Potential. (TAP) (2008). *Gaining momentum, losing ground*. Retrieved from http://www.tap2015.org/news/tap_2008_progress.pdf

Tippins, D. J. (1991). *The relationship of science self-efficacy and gender to ninth grade students' intentions to enroll in elective science courses.* (Report No. SE052385). Georgia. (ERIC Document Reproduction Service No. ED350144).

Tosun, T. (2000). The beliefs of preservice elementary teachers toward science and science teaching. *School Science and Mathematics, 100*(7), 374-379.

Tracz, S.*M*. and Gibson, S. (1986). *Teacher efficacy: Its relationship to teacher time allocation, student engagement and student achievement.* Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Tschannen-Moran, *M*., Woolfolk Hoy, A., & Hoy, W. K. (1998). Teacher efficacy: It's meaning and measure. *Review of Educational Research, 68,* 202-248.

Tschannen-Moran, *M*., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17,* 783-805.

Tschannen-Moran, *M*., & Woolfolk Hoy, A. (2007). The differential antecedents of self-efficacy: Beliefs of novice and experienced teachers. *Teaching and Teacher Education, 23,* 944-956.

Tsui, H. F. (1995). General and resource class teachers' feelings of personal efficacy and attitude towards classroom collaboration. *School Psychology International, 16(4)*, 365-377.

U. S. Government Accountability Office. (2005). *Higher education: Federal science, technology, engineering, and mathematics programs and related trends.* Washington, DC: U. S. Government Accountability Office.

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*, *78*, 751-796.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research, 54,* 143-178.

Vinson, B.*M*. (2001). A comparison of pre-service teachers' mathematics anxiety before and after a method class emphasizing manipulates, *Early Childhood Education Journal, 29*(2), 89-94.

Wheatley, K. (2002). The potential benefits of teacher efficacy doubts for educational reform, *Teaching and Teacher Education, 18*, 5-22.

White, S., & Cottle, P. (2011). *A state-by-state science and engineering readiness index (SERI): Grading states on their k-12 preparation of future scientists and engineers.* APS Physics. Retrieved from http://www.aps.org/units/fed/newsletters/summer2011/white-cottle.cfm

Wigfield, A., Eccles, J. S., & Pintrich, P. R. (1996). Development between the ages of 11 and 25. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology,* 148-185. New York: Macmillan.

Willower, D. J., Eidell, T. L., & Hoy, W. K. (1967). *The school and pupil control ideology*. (Penn State Studies Monographs No. 24). University Park: Pennsylvania State University.

Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *Academy of Management Review, 14*, 361-384.

Woolfolk, A. E (2007). *Educational Psychology.* Boston, MA: Allyn and Bacon.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control, *Journal of Educational Psychology, 82*, 81-91.

Woolfolk, A.E., Rosoff, B., & Hoy, W.K. (1990). Teachers' sense of efficacy and their beliefs about managing students. *Teaching and Teacher Education, 6,* 137-148.

Woolfolk Hoy, A., & Davis, H. A. (2006). Teacher self-efficacy and its influence on the achievement of adolescents. In F. Pajares& T. Urdan (Eds.), *Self-efficacy of adolescents* Greenwich, Connecticut: Information Age Publishing. 117-138.

Yang, B., and Clum, G.A. (2000). Childhood stress leads to later suicidality via its effects on cognitive functioning. *Suicide and Life Threatening Behavior*, *30*, 83-189.

Yasar, B., Baker, D., Robinson-Kurpius, S., Krause, S., & Roberts, C., (2006). Development of a survey to assess K-12 teachers' perceptions of engineers and familiarity with teaching design, engineering, and technology. *Journal of Engineering Education*, *July*, 205-216.

Yerrick, R. K., & Hoving, T. J. (2003). One foot on the dock and one foot on the boat: Differences among preservice science teachers' interpretations of field-based science methods in culturally diverse contexts. *Science Education, 87,* 390–418.

Zeichner, K. (1989). Preparing teachers for democratic schools. *Action in Teacher Education*, *11*(1), 5-10.

Zimmerman, B. J. (1995). Self-efficacy and educational development. In A. Bandura (Ed.), *Self-efficacy in changing societies* (pp. 202-231). New York: Cambridge University Press.

Zimmerman, B. J. (2000). Attaining self-regulation: A social-cognitive perspective. In *M.* Boekaerts, P. R. Pintrich, & *M.* Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic Press.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31*, 845-862.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, *M*. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal, 29*, 663–676.

Appendix A

RESEARCH QUESTION MATRIX

	Research Questions			
Demographic Variables	What influence do selected *demographic characteristics* have on PLTW teachers' self-efficacy?	What influence do *selected pre-PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected in-service professional development experiences* have on PLTW teacher' self-efficacy?
Gender	**FP, MS**			
Age	**FP, MS**			
Residence	**FP, MS**			
Teaching Experience	**FP, MS**			
School Setting	**FP, MS**			
# PLTW Teachers	**FP, MS**			
Teacher licensure process	**FP, MS**			
Post-secondary degrees	**FP, MS**			
Teaching endorsements	**FP, MS**			
Post-secondary credit hours	**FP, MS**			
Decision to teach the PLTW curriculum		**FP, MS**		
Non-PLTW Teaching Experience		**FP, MS**		
Student teaching completed		**FP, MS**		
Student teaching under a PLTW mentor/teacher		**FP, MS**		

FP: Frequency and Percentages of the Independent Variables
MS: Mean and Standard Deviation of Self-Efficacy Scores

	Research Questions			
Demographic Variables	What influence do selected *demographic characteristics* have on PLTW teachers' self-efficacy?	What influence do *selected pre-PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected in-service professional development experiences* have on PLTW teacher' self-efficacy?
PLTW grade levels taught			**FP, MS**	
PLTW Teaching Experience			**FP, MS**	
Semester of PLTW classes taught			**FP, MS**	
Number of PLTW sections currently being taught			**FP, MS**	

FP: Frequency and Percentages of the Independent Variables
MS: Mean and Standard Deviation of Self-Efficacy Scores

	Research Questions			
Demographic Variables	What influence do selected *demographic characteristics* have on PLTW teachers' self-efficacy?	What influence do *selected pre-PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected PLTW teaching experiences* have on PLTW teachers' self-efficacy?	What influence do *selected in-service professional development experiences* have on PLTW teacher' self-efficacy?
PLTW certification				**FP, MS**
Hours of on-line support received				**FP, MS**
Hours of on-line support provided				**FP, MS**
Hours discussing PLTW issues				**FP, MS**
Hours spent with PLTW partnership team				**FP, MS**

FP: Frequency and Percentages of the Independent Variables
MS: Mean and Standard Deviation of Self-Efficacy Scores

Appendix B

PLTW DEMOGRAPHIC SURVEY

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

1. Introduction

INSTRUCTIONS:

Thank you for taking the time to complete this survey. Your input is extremely important to the success of this research project and your input will be used to increase the knowledge base of the Self-Efficacy of Project Lead The Way Teachers.

This survey should only take about 15-20 minutes of your time. You may start the survey, exit out and then return to complete the survey at your convenience. Your answers will be completely anonymous.

Some questions require an answer in order to progress through the survey.

If you have any questions about any of this, please feel free to contact me at bholt1@vt.edu. Thanks again!

1. *ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

- **you have read the above information**
- **you voluntarily agree to participate**
- **you are at least 18 years of age**

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

○ Agree

○ Disagree

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

2. Demographic Information

This section will ask you questions related to selected demographic information. Thanks for your input.

2. What is your Gender?

- Female
- Male

3. What is your current Age?

	Years
Age in years	

4. For how many YEARS total (over your entire career, including all subjects you've taught) have you been teaching?

Years you have been teaching	

5. In what state do you currently teach?

State:

6. How would you describe your current school setting?

	Public	Private Non-Parochial	Private Parochial	Charter	Other
School Setting					

7. How many other teachers at your school are currently teaching PLTW courses?

	0	1	2	3	4	5	6	7	8	9	10	>10
Number of PLTW teachers												

8. How did you receive your license to teach?

- I DO NOT currently hold a teaching license, and I am NOT working toward earning a teaching license.
- I DO NOT currently hold a teaching license, but I AM working toward earning a teaching license.
- I was awarded a teaching license after earning a degree in an EDUCATIONAL field.
- I was awarded a teaching license, although I have NOT earned a degree in an EDUCATIONAL field.

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

9. Select all post-secondary degrees you have COMPLETED.

	Bachelor's Degree	Master's Degree	Ed.D or Ph.D
Math Education	☐	☐	☐
Science Education	☐	☐	☐
Technology Education	☐	☐	☐
Engineering Education	☐	☐	☐
Math (Non-Education)	☐	☐	☐
Science (Non-Education)	☐	☐	☐
Engineering	☐	☐	☐
Education	☐	☐	☐
Other	☐	☐	☐

If you selected "Other" above, indicate the degree(s) and major(s) in which you earned one or more degrees that aren't listed above

______

10. Select all post-secondary degrees you have NOT completed but are currently working toward (presently taking classes or have taken classes in the last year).

	Bachelor's Degree	Master's Degree	Ed.D or Ph.D
Math Education	☐	☐	☐
Science Education	☐	☐	☐
Technology Education	☐	☐	☐
Engineering Education	☐	☐	☐
Math (Non-Education)	☐	☐	☐
Science (Non-Education)	☐	☐	☐
Engineering	☐	☐	☐
Education	☐	☐	☐
Other	☐	☐	☐

If you selected "Other" above, indicate the degree(s) and major(s) in which you earned one or more degrees that aren't listed above

______

11. Select all valid teaching endorsements by GRADE LEVELS that you currently hold.

	K	1	2	3	4	5	6	7	8	9	10	11	12
Math Education	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Science Education	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Technology Education	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
STEM Education	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

If you selected "Other," please list other endorsements and grade levels for which you hold teaching licenses.

______

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

3. Pre-Service Teacher Education

12. Estimate the number of post-secondary SEMESTER HOURS you have completed in each of the following disciplines. If you have been enrolled in program that used quarter hours, convert quarter hours such that, 3 QUARTER HOURS = 2 SEMESTER HOURS.

	0	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	More than 24
Mathematics										
Math Education										
Science										
Science education										
Technology										
Technology Education										
Engineering										
Vocational T & I Education										
Curriculum and Instruction										

13. At which grade levels do you currently teach PLTW courses (Check all that apply)?

	5	6	7	8	9	10	11	12
Grade Level								

14. Whose decision led you to become certified to teach the PLTW curriculum?

- Self
- Department Head
- Principal or Assistant Principal
- Superintendent or Assistant Superintendent
- Area Supervisor
- Other

If you selected "Other" please indicate the position/title held by this individual

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

15. Indicate the number of years you have taught the following subjects.

	Years
Project Lead The Way	
Mathematics	
Science	
Technology Education	
Engineering (other than PLTW)	
Vocational T & I Education	

16. For each of the following PLTW classes, select the appropriate certification process you followed to become certified.

	Two Week Summer Training	Post Secondary Courses	Not Certified
PLTW: Gateway to Technology			
PLTW: Intro to Engineering Design			
PLTW: Principles to Engineering			
PLTW: Digital Electronics			
PLTW: Computer Integrated Manufacturing			
PLTW: Civil Engineering and Architecture			
PLTW: Biotechnical Engineering			
PLTW: Aerospace Engineering			
PLTW: Engineering Design and Development			

17. Including this year, how many total SEMESTERS have you taught the following PLTW courses?

	0	1	2	3	4	5	6	7	8	9	10	>10
Middle School PLTW: Gateway to Technology												
High School PLTW: Intro to Engineering Design												
High School PLTW: Principles of Engineering												
High School PLTW: Digital Electronics												
High School PLTW: Computer Integrated Manufacturing												
High School PLTW: Civil Engineering and Architecture												
High School PLTW: Biotechnical Engineering												
High School PLTW: Aerospace Engineering												
High School PLTW: Engineering Design and Development												

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

18. How many SECTIONS of each of the following classes did you teach this THIS PAST FALL SEMESTER?

	0	1	2	3	4	5	>5
Middle School PLTW: Gateway to Technology							
Middle School Mathematics Classes							
Middle School Science Classes							
Middle School Technology Education Classes							
Middle School Engineering (other than PLTW) Classes							
Other Middle School Classes							
High School PLTW: Intro to Engineering Design							
High School PLTW: Principles of Engineering							
High School PLTW: Digital Electronics							
High School PLTW: Computer Integrated Manufacturing							
High School PLTW: Civil Engineering and Architecture							
High School PLTW: Biotechnical Engineering							
High School PLTW: Aerospace Engineering							
High School PLTW: Engineering Design and Development							
High School Mathematics Classes							
High School Science Classes							
High School Technology Education Classes							
High School Engineering (other than PLTW) Classes							
Other High School Classes							

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

19. How many SECTIONS of each of the following classes ARE YOU CURRENTLY TEACHING this spring semester?

	0	1	2	3	4	5	>5
Middle School PLTW: Gateway to Technology							
Middle School Mathematics Classes							
Middle School Science Classes							
Middle School Technology Education Classes							
Middle School Engineering (other than PLTW) Classes							
Other Middle School Classes							
High School PLTW: Intro to Engineering Design							
High School PLTW: Principles of Engineering							
High School PLTW: Digital Electronics							
High School PLTW: Computer Integrated Manufacturing							
High School PLTW: Civil Engineering and Architecture							
High School PLTW: Biotechnical Engineering							
High School PLTW: Aerospace Engineering							
High School PLTW: Engineering Design and Development							
High School Mathematics Classes							
High School Science Classes							
High School Technology Education Classes							
High School Engineering (other than PLTW) Classes							
Other High School Classes							

20. On average, how many HOURS of PLTW online support do you RECEIVE monthly?

	0	1	2	3	4	5	6	7	8	9	10	>10
Hours												

21. On average, how many HOURS of PLTW online support do you PROVIDE monthly?

	0	1	2	3	4	5	6	7	8	9	10	>10
Hours												

22. On average, how many HOURS PER MONTH do you spend discussing PLTW-related teaching issues ONLINE with fellow PLTW teachers?

	0	1	2	3	4	5	6	7	8	9	10	>10
Hours												

23. On average, how many HOURS PER YEAR do you spend with your (Business/Industry) PLTW Partnership Team?

	0	1	2	3	4	5	6	7	8	9	10	>10
Hours												

An Exploratory Study of the Self-Efficacy of Project Lead The Way Teachers

4. Teachers with less than five years of teaching experience

The questions below are only relevant to teachers who have been teaching less than five years. If you have completed five years or more of teaching, please proceed to question 27.

24. Did you complete a student teaching experience as part of your teacher preparation program?

- Yes
- No

25. Did you student teach under a PLTW mentor/teacher?

- Yes
- No

26. If you answered "yes" above, select the class(es) in which you had an ACTIVE student teaching role.

	Student Teaching Role	Did not have an Active Student Teaching Role
Middle School PLTW: Gateway to Technology		
High School PLTW: Intro to Engineering Design		
High School PLTW: Principles of Engineering		
High School PLTW: Digital Electronics		
High School PLTW: Computer Integrated Manufacturing		
High School PLTW: Civil Engineering and Architecture		
High School PLTW: Biotechnical Engineering		
High School PLTW: Aerospace Engineering		
High School PLTW: Engineering Design and Development		

Appendix C

TEACHER'S SELF-EFFICACY BELIEF SYSTEM - SELF (TEBS-S)[3]

Response scale:
1. Weak beliefs in my capabilities
2. Moderate beliefs in my capabilities
3. Strong beliefs in my capabilities
4. Very strong beliefs in my capabilities

1. Plan activities that accommodate the range of individual differences among my students	1	2	3	4
2. Plan evaluation procedures that accommodate individual differences among my students	1	2	3	4
3. Use allocated time for activities that maximize learning	1	2	3	4
4. Effectively manage routines and procedures for learning tasks	1	2	3	4
5. Clarify directions for learning routines	1	2	3	4
6. Maintain high levels of student engagement in learning tasks	1	2	3	4
7. Redirect students who are persistently off task	1	2	3	4
8. Maintain a classroom climate of courtesy and respect	1	2	3	4
9. Maintain a classroom climate that is fair and impartial	1	2	3	4
10. Communicate to students the specific learning outcomes of the lesson	1	2	3	4
11. Communicate to students the purpose and/or importance of learning tasks	1	2	3	4
12. Implement teaching methods at an appropriate pace to accommodate differences among my students	1	2	3	4
13. Utilize teaching aids and learning materials that accommodate individual differences among my students	1	2	3	4
14. Provide students with opportunities to learn at more than one cognitive and/or performance level	1	2	3	4
15. Communicate to students content knowledge that is accurate and logical	1	2	3	4
16. Clarify student misunderstandings or difficulties in learning	1	2	3	4
17. Provide students with specific feedback about their learning	1	2	3	4
18. Provide students with suggestions for improving learning	1	2	3	4
19. Actively involve students in developing concepts	1	2	3	4
20. Solicit a variety of questions throughout the lesson that enable higher order thinking	1	2	3	4
21. Actively involve students in critical analysis and/or problem solving	1	2	3	4

[3] The developer of this instrument recommends its use to researchers or practitioners such as principals or school administrators, stipulating that items may be added or adjusted as appropriate (Dellinger et al., 2008).

22. Monitor students' involvement during learning tasks	1 2 3 4
23. Adjust teaching and learning activities as needed	1 2 3 4
24. Manage student discipline/behavior	1 2 3 4
25. Involve students in developing higher order thinking skills	1 2 3 4
26. Motivate students to perform to their fullest potential	1 2 3 4
27. Provide a learning environment that accommodates students with special needs	1 2 3 4
28. Improve the academic performance of students, including those with learning disabilities	1 2 3 4
29. Provide a positive influence on the academic development of students	1 2 3 4
30. Maintain a classroom environment in which students work cooperatively	1 2 3 4
31. Successfully maintain a positive classroom climate	1 2 3 4

Cronbach's alpha Coefficients for the TEBS-S

Dimension	Cronbach's alpha Coefficient
Accommodating Individual Differences (AID)	.87
Managing Learning Routines (MLR)	.80
Maintaining a Positive Classroom Climate (CC)	.86
Monitoring and Feedback for Learning (MFL)	.86

Questions Related to Instrument Dimensions

Dimension	Questions Addressing Dimensions
Accommodating Individual Differences (AID)	Item: 1, 2, 12, 13, 14, 27, 28
Managing Learning Routines (MLR)	Item: 3, 4, 5
Maintaining a Positive Classroom Climate (CC)	Item: 3, 4, 5, 6, 7, 8, 9, 24, 30, 31
Monitoring and Feedback for Learning (MFL)	Item: 5, 10, 11, 15, 16, 17, 18, 22, 23

Appendix D

PILOT STUDY: PARTICIPANT E-MAIL SURVEY INVITATION

Dear PLTW Teacher:

In an effort to continually improve the quality of PLTW programs, I am working with a researcher from Virginia Tech who is conducting research on the teacher self-efficacy (extent to which you believe in your ability to affect student performance) of PLTW teachers. I believe that this research is beneficial to the PLTW program in that we have limited information as to how demographic, pre-service, and in-service factors may enhance or inhibit the self-efficacy of PLTW teachers. I am optimistic the results of this study will assist us in providing practicing PLTW teachers with a stronger support system.

With this in mind, we would really appreciate it if you would take about 20 minutes to complete the confidential pilot study survey you'll find at:
https://www.//xxxxxxxxx. If you could complete this survey within the next four days, we would appreciate it. Thanks in advance for your help with this effort!

Director, Assessment and Evaluation
Project Lead the Way, Inc.
Iowa City, IA

Appendix E

PARTICIPANT INITIAL E-MAIL SURVEY INVITATION

Dear Fellow PLTW Teacher:

In an effort to continually improve the quality of PLTW programs, I am working with a researcher from Virginia Tech who is conducting research on the self-efficacy (extent to which you believe in your ability to affect student performance) of engineering educators. I believe that this research is beneficial to the PLTW program in that we have limited information as to how demographic, pre-service, and in-service factors may enhance or inhibit the self-efficacy of engineering. I am optimistic the results of this study will assist us in providing practicing PLTW teachers with a stronger support system.

With this in mind, we would really appreciate it if you would take about 20 minutes to complete the confidential survey you'll find at: https://www.//xxxxxxxxx. If you could complete this survey within the next four days, we would appreciate it. Thanks in advance for your help with this effort!

Note: if you were one of the teachers who participated in the Engineering Educators' Self-Efficacy Pilot Study in March, we would ask that you do not participate in this study. We do appreciate the valuable input that you provided.

Director, Assessment and Evaluation
Project Lead the Way, Inc.
Iowa City, IA

Appendix F

PARTICIPANT SECONDARY E-MAIL SURVEY INVITATION

Dear PLTW Teacher:

About 4 days ago, I sent you an e-mail requesting your participation in Web based survey, we believe will benefit all PLTW teachers. If you have already completed this survey, know that we really appreciate your doing so. If you have haven't yet completed the survey, it would be a big help to us (and all PLTW teachers) if you would take a few minutes to complete the survey now or within the next 48 hours. You may access it at https://www.//xxxxxxxxx. Your responses will remain completely anonymous. Thanks in advance for your help with this effort!

Director, Assessment and Evaluation
Project Lead the Way, Inc.
Iowa City, IA

Appendix G

RESEARCH TIMELINE

DATE	ACTION
February11, 2011	Prospectus Exam
February11, 2011	Submit IRB form to Virginia Tech for Approval
February 18, 2011	• Virginia Tech Approval of IRB • Inform the PLTW Director of Assessment and PLTW Director, Market Development and Relationships that the IRB has been approved. • Coordinate with the PLTW Directors to finalize the selection of 100 Pilot Study participants. • Web based Instrument (Pilot Study Version) finalized and added to Survey Monkey. • Inform the PLTW Director that the Web based Instrument (Pilot Study Version) is available for his review.
February 21, 2011	Approval from PLTW Director that the Web based Instrument (Pilot Study Version) is acceptable. The PLTW Director informed that the Pilot Study can begin
February 28, 2011	PLTW Director submits e-mail (See Appendix D) to 100 PLTW teachers requesting that they complete the Pilot Study.
March 4, 2011	PLTW Director submits e-mail (second contact) to approximately 100 PLTW teachers reminding the teachers to complete the PLTW the Pilot Study.
March 8, 2011	PLTW Director submits e-mail (third contact) to approximately 100 PLTW teachers reminding the teachers to complete the PLTW the Pilot Study

DATE	ACTION
March 12, 2011	Pilot Study is closed and researcher begins the evaluation of the results.
March 19, 2011	Researcher finalizes Web based Instrument (Final Study Version) and informs the PLTW Director that the initial invitation e-mail is ready to be submitted to prospective PLTW teacher-participants.
March 21, 2011	PLTW Director submits e-mail (See Appendix E) to approximately 7,300 PLTW teachers requesting that they complete the PLTW Self-Efficacy Study.
March 25, 2011	PLTW Director submits e-mail (second contact) (See Appendix F) to approximately 7,300 PLTW teachers reminding the teachers to complete the PLTW Self-Efficacy Study.
March 30, 2011	PLTW Director submits e-mail (third contact) to approximately 7,300 PLTW teachers reminding the teachers to complete the PLTW Self-Efficacy Study.
April 6, 2011	• The PLTW Self-Efficacy Survey is closed and the access to the survey is removed. • Researcher begins analyzing data
April 21, 2011	Researcher completes the analysis.
April 28, 2011	Researcher begins writing Chapters IV and V
July 24, 2011	Researcher completes Chapters IV and V. Results and findings added to Abstract.
July 24, 2011 through September 20, 2011	Researcher carefully reviews dissertation and makes necessary revisions.
September 20, 2011	Researcher submits Application for Degree.
September 23, 2011	Researcher submits to Virginia Tech: *Defending Student Status form with the Request to be Admitted to the Final Exam*.

DATE	ACTION
October 17, 2011	• Final Draft of Dissertation is completed. • Final draft of dissertation is submitted to committee.
October 24, 2011	Dissertation Defense.
November 11, 2011	Final revisions and corrects stipulated by Graduate Committee are completed.
November 14, 2011	Researcher submits, *PhD ETD Submission*
December 16, 2011	Fall Commencement

Appendix H

PILOT STUDY TABLES

Table H1
Pilot Study: Gender of Participants (n = 30)

Gender	Frequency	Percent
Male	23	76.67%
Female	7	23.33%

Table H2
Pilot Study: Age of Participants (n = 30)

Gender	Average Age	*SD*	Range	
			Minimum	Maximum
Male	45.57	13.02	23	70
Female	40.14	11.63	28	58
Overall	44.30	12.73	23	70

Table H3
Pilot Study: Years of Teaching Experience (n = 29)

Average Experience	*SD*	Range	
		Minimum	Maximum
16.21	10.54	1	35

Table H4
Pilot Study: Post-Secondary Degrees Completed (n = 30)

Content Area	Bachelor's	Master's	Ed.D or Ph.D.
Math Education	2	1	0
Science Education	6	2	0
Technology Education	13	5	1
Engineering Education	1	1	0
Math Non-Education	0	0	0
Science Non-Education	4	1	0
Engineering	3	0	0
Education	5	6	0
Other	5	5	0
Total	39	21	1

Table H5
Pilot Study: Licensure Process (n = 30)

License Process	Frequency	Percent
Awarded a teaching license after earning a degree in an educational field	26	86.7%
Awarded a teaching license, but had not earned a degree in an educational field.	4	13.3%

Table H6
Pilot Study: Cronbach Alpha (n = 30)

Dimension	Cronbach's Alpha Coefficient Instrument Values	Cronbach's Alpha Coefficient Pilot Study Values
Accommodating Individual Differences (AID)	.87	.862
Managing Learning Routines (MLR)	.80	.873
Maintaining a Positive Classroom Climate (CC)	.86	.885
Monitoring and Feedback for Learning (MFL)	.86	.899

Table H7
Pilot Study: Cronbach Alpha Coefficient: Accommodating Individual Differences (AID)

TEBS-S Questions associated with measuring *Accommodating Individual Differences*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. Plan activities that accommodate the range of individual differences among my students.	20.97	7.826	.594	.884
2. Plan evaluation procedures that accommodate individual differences among my students.	21.00	7.379	.754	.865
12. Implement teaching methods at an appropriate pace to accommodate differences among my students.	20.93	7.789	.612	.882
13. Utilize teaching aids and learning materials that accommodate individual differences among my students.	21.03	7.482	.718	.870
14. Provide students with opportunities to learn at more than one cognitive and/or performance level.	20.87	7.913	.689	.875
27. Provide a learning environment that accommodates students with special needs.	21.10	7.334	.693	.873
28. Improve the academic performance of students, including those with learning disabilities	21.10	6.921	.754	.865

Table H8

Pilot Study: Cronbach Alpha Coefficient: Managing Learning Routines (MLR)

TEBS-S Questions associated with measuring *Managing Learning Routines*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
3. Use allocated time for activities that maximize learning	6.77	1.423	.638	.785
4. Effectively manage routines and procedures for learning tasks	6.72	1.351	.722	.697
5. Clarify directions for learning routines	6.70	1.485	.656	.765

Table H9

Pilot Study: Cronbach Alpha Coefficient: Maintaining a Positive Classroom Climate (CC)

TEBS-S Questions associated with measuring *Maintaining a Positive Classroom Climate*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
3. Use allocated time for activities that maximize learning.	32.73	9.651	.607	.874
4. Effectively manage routines and procedures for learning tasks.	32.70	9.390	.697	.867
5. Clarify directions for learning routines.	32.63	9.620	.623	.873
6. Maintain high levels of student engagement in learning tasks.	32.67	9.678	.597	.875
7. Redirect students who are persistently off task.	32.77	9.151	.683	.869
8. Maintain a classroom climate of courtesy and respect.	32.47	9.568	.737	.866
9. Maintain a classroom climate that is fair and impartial.	32.47	9.913	.602	.875
24. Manage student discipline/behavior.	32.50	9.569	.706	.867
30. Maintain a classroom environment in which students work cooperatively.	32.47	10.189	.409	.889
31. Successfully maintain a positive classroom climate.	32.40	10.248	.540	.879

Table H10

Pilot Study: Cronbach Alpha Coefficient: Monitoring and Feedback for Learning (MFL)

TEBS-S Questions associated with measuring *Monitoring and Feedback for Learning*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
5. Clarify directions for learning routines	28.67	8.920	.794	.877
10. Communicate to students the specific learning outcomes of the lesson	28.67	9.333	.642	.889
11. Communicate to students the purpose and/or importance of learning tasks	28.63	9.068	.749	.881
15. Communicate to students content knowledge that is accurate and logical	28.63	9.275	.673	.887
16. Clarify student misunderstandings or difficulties in learning	28.63	9.344	.648	.889
17. Provide students with specific feedback about their learning	28.70	8.976	.661	.888
18. Provide students with suggestions for improving learning	28.70	8.838	.818	.875
22. Monitor students' involvement during learning tasks	28.63	9.689	.525	.898
23. Adjust teaching and learning activities as needed	28.60	9.834	.485	.901

Table H11

Pilot Study: Average Time to Complete the Survey (n = 30)

Average Time	Mode	*SD*	Range	
			Minimum	Maximum
15.56	10	5.00	10	30

Appendix I

CONTENT VALIDITY TABLES

Table I1
Qualifications of Experienced Professionals

Qualifications	Experienced Professional Members					
	#1	#2	#3	#4	#5	#6
Professional title						
Teacher	x	x	x	x	x	
Professor Integrative STEM Education						x
Education:						
Bachelor Degree(s)	x	x	x	x	x	x
Master's Degree(s)	x		x	x	x	x
PhD Degree(s)						x
K-12 Educational Experience (years)						
K12: Project Lead the Way classes	6	9	4	6	5	
K12: Mathematics classes						
K12: Science classes		17				
K12: Technology Education classes			16	7	10	2
K12: Engineering classes (other than PLTW)				4	2	
K12: Vocational T&I Education classes				1	3	
Total K-12 Educational Experience	6	26	20	18	20	2
Post-Secondary Experience (years)						
Technology and Engineering Education						34
Additional Qualifications						
PLTW Core Trainer	x					
Certified Master Teacher		x				
Engineering Advisory Committee					x	

Table I2

Content Expert Ratings of Survey Questions for Relevance to Research Questions

	Experienced Professional Members					
Survey Questions	#1	#2	#3	#4	#5	#6
1. What is your gender?	4	4	4	4	4	4
2. What is your current age?	4	4	4	4	3	4
3. For how many years total (over your entire career including all subjects you have taught) have you been teaching?	4	4	4	4	4	4
4. In what state do you currently teach?	4	4	4	4	1	4
5. How would you describe your current school setting?	4	4	4	4	1	3
6. How many PLTW teachers (including yourself) are employees of your current school?	4	4	4	4	1	4
7. How did you receive your license to teach?	4	4	4	4	4	4
8. Select all post-secondary degrees you have completed.	4	4	4	4	4	4
9. Select all post-secondary degrees you have not completed but are currently working toward (presently taking classes or have taken classes in the last year).	4	4	4	4	4	4
10. Select all valid teaching endorsements by grade level that you currently hold.	4	4	4	4	4	4
11. List the number of post-secondary semester hours you have completed in each of the following disciplines. If you have been enrolled in a program that used quarter hours, please convert hours such that, 3 quarter hours = 2 semester hours	4	4	4	4	2	4
12. At which grade levels do you currently teach PLTW courses?	4	4	4	4	4	4
13. Whose decision led you to become certified to teach the PLTW curriculum?	4	4	3	4	4	4

(Continued)

Table I2 *Continued*

	Experienced Professional Members					
Survey Questions	#1	#2	#3	#4	#5	#6
14. Select the percentage of time over your entire K-12 teaching career that you have taught the following school subjects (total of percentages must equal 100)	4	4	3	4	4	4
15. For each of the following PLTW classes, select the appropriate certification process you followed to become certified.	4	4	4	4	4	4
16. Including this year, how many total semesters have you taught the following PLTW courses?	4	4	4	4	4	4
17. How many sections of each of the following classes did you teach this past semester?	4	4	4	4	4	4
18. How many sections of each of the following classes are you currently teaching this spring semester?	4	4	4	4	4	4
19. On average, how many hours of PLTW online support do you engage in monthly?	4	4	4	3	4	4
20. On average, how many hours per month do you spend networking with fellow PLTW teachers?	4	4	4	3	4	4
21. On average, how many hours per month do you spend with your (Business/Industry) PLTW team?	4	4	4	3	4	4
22. Did you complete a student teaching experience as part of your teacher preparation program?	4	4	3	4	3	4
23. Did you student teach under a PLTW mentor/teacher	4	4	3	4	4	4
24. If you answered "yes" above, select the class (es) in which you had an active student teaching role.	4	4	4	4	4	4

Note. Rating of 1 = Survey question is NOT relevant in addressing the research question; 2 = Survey question needs major revisions to be relevant in addressing the research question; 3 = Survey question needs minor revisions to be relevant in addressing research question; 4 = Survey question is relevant in addressing the research question.

Table I3

Content Validity Index of Survey Questions for Relevance to Research Questions

Demographic Question	EPM #1	EPM #2	EPM #3	EPM #4	EPM #5	EPM #6	EPM in Agreement	Item CVI
Question 1	x	x	x	x	x	x	6	1.00
Question 2	x	x	x	x	x	x	6	1.00
Question 3	x	x	x	x	x	x	6	1.00
Question 4	x	x	x	x	-	x	5	0.83
Question 5	x	x	x	x	-	x	5	0.83
Question 6	x	x	x	x	-	x	5	0.83
Question 7	x	x	x	x	x	x	6	1.00
Question 8	x	x	x	x	x	x	6	1.00
Question 9	x	x	x	x	x	x	6	1.00
Question 10	x	x	x	x	x	x	6	1.00
Question 11	x	x	x	x	-	x	5	0.83
Question 12	x	x	x	x	x	x	6	1.00
Question 13	x	x	x	x	x	x	6	1.00
Question 14	x	x	x	x	x	x	6	1.00
Question 15	x	x	x	x	x	x	6	1.00
Question 16	x	x	x	x	x	x	6	1.00
Question 17	x	x	x	x	x	x	6	1.00
Question 18	x	x	x	x	x	x	6	1.00
Question 19	x	x	x	x	x	x	6	1.00
Question 20	x	x	x	x	x	x	6	1.00
Question 21	x	x	x	x	x	x	6	1.00
Question 22	x	x	x	x	x	x	6	1.00
Question 23	x	x	x	x	x	x	6	1.00
Question 24	x	x	x	x	x	x	6	1.00
Mean I-CVI								0.97
	24/24	24/24	24/24	24/24	20/24	24/24		
SCVI	1.00	1.00	1.00	1.00	0.83	1.00		
Mean SCVI								0.97

Note. Dashes indicate rankings of 1 or 2. Markers of ***x*** indicate rankings of 3 or 4. CVI = Content Validity Index. I-CVI = Item-Level Content Validity Index. SCVI = Scale-Level Content Validity Index (Polit & Beck, 2006). EPM: Experienced Professional Member.

Table I4

Content Expert Ratings of Survey Questions for Clarity

Survey Question	EPM #1	EPM #2	EPM #3	EPM #4	EPM #5	EPM #6
1. What is your gender?	4	4	4	4	4	4
2. What is your current age?	4	4	4	4	4	4
3. For how many years total (over your entire career including all subjects you have taught) have you been teaching?	4	4	4	4	4	4
4. In what state do you currently teach?	4	4	4	4	4	4
5. How many PLTW teachers (including yourself) are employees of your current school?	4	4	4	4	4	4
6. How did you receive your license to teach?	4	4	3	4	4	4
7. Select all post-secondary degrees you have completed.	4	4	3	4	4	4
8. Select all post-secondary degrees you have not completed but are currently working toward (presently taking classes or have taken classes in the last year).	4	4	4	4	4	4
9. Select all valid teaching endorsements by grade level that you currently hold.	4	4	3	4	4	4
10. List the number of post-secondary semester hours you have completed in each of the following disciplines. If you have been enrolled in a program that used quarter hours, please convert hours such that, 3 quarter hours = 2 semester hours	4	4	2	4	4	4
11. At which grade levels do you currently teach PLTW courses?	4	4	4	4	4	4
12. Whose decision led you to become certified to teach the PLTW curriculum?	4	4	3	4	4	4

(Continued)

Table I4 *Continued*

Survey Question	EPM #1	EPM #2	EPM #3	EPM #4	EPM #5	EPM #6
13. Select the percentage of time over your entire K-12 teaching career that you have taught the following school subjects (total of percentages must equal 100)	4	4	3	4	4	4
14. For each of the following PLTW classes, select the appropriate certification process you followed to become certified.	4	4	4	4	4	4
15. Including this year, how many total semesters have you taught the following PLTW courses?	4	4	4	4	4	4
16. How many sections of each of the following classes did you teach this past semester?	4	4	3	4	4	4
17. How many sections of each of the following classes are you currently teaching this spring semester?	4	4	4	4	4	4
18. On average, how many hours of PLTW online support do you engage in monthly?	4	4	3	4	3	4
19. On average, how many hours per month do you spend networking with fellow PLTW teachers?	4	4	4	3	4	4
20. On average, how many hours per month do you spend with your (Business/Industry) PLTW team?	4	4	4	3	4	4
21. Did you complete a student teaching experience as part of your teacher preparation program?	4	4	3	4	3	4
22. Did you student teach under a PLTW mentor/teacher?	4	4	3	4	4	4
23. If you answered "yes" above, select the class (es) in which you had an active student teaching role.	4	4	3	4	4	4

Note. Rating of 1 = Survey question is not clear; 2 = Survey question needs major revisions to be clear; 3 = Survey question needs minor revisions to be clear; 4 = Survey question is clear. EPM: Experienced Professional Member.

Table I5

Content Validity Index of Survey Questions for Clarity

Demographic Question	EPM #1	EPM #2	EPM #3	EPM #4	EPM #5	EPM #6	EPM in Agreement	Item CVI
Question 1	x	x	x	x	x	x	6	1.00
Question 2	x	x	x	x	x	x	6	1.00
Question 3	x	x	x	x	x	x	6	1.00
Question 4	x	x	x	x	x	x	6	1.00
Question 5	x	x	x	x	x	x	6	1.00
Question 6	x	x	x	x	x	x	6	1.00
Question 7	x	x	x	x	x	x	6	1.00
Question 8	x	x	x	x	x	x	6	1.00
Question 9	x	x	x	x	x	x	6	1.00
Question 10	x	x	x	x	x	x	6	1.00
Question 11	x	x	-	x	x	x	5	0.83
Question 12	x	x	x	x	x	x	6	1.00
Question 13	x	x	x	x	x	x	6	1.00
Question 14	x	x	x	x	x	x	6	1.00
Question 15	x	x	x	x	x	x	6	1.00
Question 16	x	x	x	x	x	x	6	1.00
Question 17	x	x	x	x	x	x	6	1.00
Question 18	x	x	x	x	x	x	6	1.00
Question 19	x	x	x	x	x	x	6	1.00
Question 20	x	x	x	x	x	x	6	1.00
Question 21	x	x	x	x	x	x	6	1.00
Question 22	x	x	x	x	x	x	6	1.00
Question 23	x	x	x	x	x	x	6	1.00
Question 24	x	x	x	x	x	x	6	1.00
Mean I-CVI								0.99
	24/24	24/24	23/24	24/24	24/24	24/24		
SCVI	1.00	1.00	0.96	1.00	1.00	1.00		
Mean SCVI								0.99

Note. Dashes indicate rankings of 1 or 2. Markers of "x" indicate rankings of 3 or 4. CVI = Content Validity Index. I-CVI = Item-Level Content Validity Index. SCVI = Scale-Level Content Validity Index (Polit & Beck, 2006). EPM: Experienced Professional Member.

Table I6

Study Survey Question Modifications

Original Survey Question	Modified Survey Question
11. List the number of post-secondary semester hours you have completed in each of the following disciplines. If you have been enrolled in a program that used quarter hours, please convert hours such that, 3 quarter hours = 2 semester hours	11. List (estimate if necessary) the number of post-secondary semester hours you have completed in each of the following disciplines. If you have been enrolled in a program that used quarter hours, please convert hours such that, 3 quarter hours = 2 semester hours
15. Select the percentage of time over your entire K-12 teaching career that you have taught the following school subjects (total of percentages must equal 100)	15. Select the percentage of time over your entire K-12 teaching career that you have taught the following school subjects (total CANNOT exceed 100%)

Appendix J

STUDY TABLES

Table J1

Cronbach Alpha (n = 1157)

Dimension	Cronbach's Alpha Coefficient Instrument Values	Cronbach's Alpha Coefficient Study Values
Accommodating Individual Differences (AID)	.87	.900
Managing Learning Routines (MLR)	.80	.818
Maintaining a Positive Classroom Climate (CC)	.86	.911
Monitoring and Feedback for Learning (MFL)	.86	.909

Table J2

Cronbach Alpha Coefficients: Accommodating Individual Differences (AID)

TEBS-S Questions associated with measuring *Accommodating Individual Differences*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. Plan activities that accommodate the range of individual differences among my students.	19.10	11.723	.705	.885
2. Plan evaluation procedures that accommodate individual differences among my students.	19.22	11.660	.709	.885
12. Implement teaching methods at an appropriate pace to accommodate differences among my students.	19.13	11.980	.692	.887
13. Utilize teaching aids and learning materials that accommodate individual differences among my students.	19.11	11.574	.744	.881
14. Provide students with opportunities to learn at more than one cognitive and/or performance level.	19.08	11.862	.681	.888
27. Provide a learning environment that accommodates students with special needs.	19.16	11.744	.688	.887
28. Improve the academic performance of students, including those with learning disabilities	19.15	11.885	.724	.883

Table J3
Cronbach Alpha Coefficients: Managing Learning Routines (MLR)

TEBS-S Questions associated with measuring *Managing Learning Routines*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
3. Use allocated time for activities that maximize learning	6.77	1.423	.638	.785
4. Effectively manage routines and procedures for learning tasks	6.72	1.351	.722	.697
5. Clarify directions for learning routines	6.70	1.485	.656	.765

Table J4

Cronbach Alpha Coefficients: Maintaining a Positive Classroom Climate (CC)

TEBS-S Questions associated with measuring *Maintaining a Positive Classroom Climate*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
3. Use allocated time for activities that maximize learning.	31.22	18.035	.637	.905
4. Effectively manage routines and procedures for learning tasks.	31.17	17.807	.696	.901
5. Clarify directions for learning routines.	31.15	18.187	.655	.904
6. Maintain high levels of student engagement in learning tasks.	31.21	17.763	.708	.900
7. Redirect students who are persistently off task.	31.27	17.993	.621	.906
8. Maintain a classroom climate of courtesy and respect.	30.97	18.227	.703	.901
9. Maintain a classroom climate that is fair and impartial.	30.90	18.688	.688	.902
24. Manage student discipline/behavior.	31.06	18.117	.670	.903
30. Maintain a classroom environment in which students work cooperatively.	30.99	18.380	.708	.901
31. Successfully maintain a positive classroom climate.	30.96	18.366	.715	.900

Table J5

Cronbach Alpha Coefficients: Monitoring and Feedback for Learning (MFL)

TEBS-S Questions associated with measuring *Monitoring and Feedback for Learning*	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
5. Clarify directions for learning routines	26.85	16.149	.670	.901
10. Communicate to students the specific learning outcomes of the lesson	26.92	15.710	.705	.898
11. Communicate to students the purpose and/or importance of learning tasks	26.87	15.890	.715	.897
15. Communicate to students content knowledge that is accurate and logical	26.78	16.272	.682	.900
16. Clarify student misunderstandings or difficulties in learning	26.90	16.159	.694	.899
17. Provide students with specific feedback about their learning	27.01	15.729	.720	.897
18. Provide students with suggestions for improving learning	26.99	15.736	.694	.899
22. Monitor students' involvement during learning tasks	26.84	16.240	.661	.901
23. Adjust teaching and learning activities as needed	26.83	16.148	.662	.901

Table J6

Frequency Distribution Based on Gender of PLTW Teachers

Dimension	*N*	%
Gender		
Female	314	27.38
Male	833	72.62
Number of Respondents	1147	100.00
Number of Non-Respondents	10	

Table J7

Teacher Self-Efficacy Means Based on Gender of PLTW Teachers (n = 1147)

Gender	AID	MLR	CC	MFL	OSE
Female	3.17	3.34	3.42	3.34	3.30
	.60	.61	.49	.54	.50
Male	3.20	3.38	3.47	3.37	3.35
	.56	.55	.46	.48	.45
Total	3.17	3.34	3.42	3.34	3.34
	.60	.61	.49	.54	.47

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J8

ANOVA for Overall Teacher Self-Efficacy Means Based on Gender of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.579	1	.579	2.66	.10**
Within Groups	249.30	1145	.218		
Total	249.88	1146			

Note. **Significance at the $p<.05$ level.

Table J9

Frequency Distribution Based on Ages of PLTW Teachers

Dimension	Mean	*SD*	*N*	%
Age (22-73 years old)	44.82	10.73		
20-24			13	1.13
25-29			99	8.62
30-34			143	12.46
35-39			131	11.41
40-44			132	11.50
45-49			196	17.07
50-54			205	17.86
55-59			131	11.41
60-64			79	6.88
65-69			18	1.57
70-74			1	0.09
Number of Respondents			1148	100.00
Number of Non-Respondents			9	

Table J10

Teacher Self-Efficacy Means Based on Age of PLTW Teachers (n = 1148)

Age		AID	MLR	CC	MFL	OSE
20-24	*M*	3.31	3.23	3.41	3.36	3.34
	SD	.42	.52	.46	.39	0.40
25-29	*M*	3.33	3.11	3.37	3.26	3.25
	SD	.61	.58	.50	.52	0.49
30-34	*M*	3.40	3.19	3.48	3.36	3.34
	SD	.55	.57	.46	.50	0.47
35-39	*M*	3.28	3.13	3.40	3.31	3.30
	SD	.63	.61	.51	.56	0.52
40-44	*M*	3.43	3.24	3.51	3.41	3.38
	SD	.55	.57	.46	.49	0.47
45-49	*M*	3.31	3.13	3.44	3.30	3.29
	SD	.60	.55	.47	.49	0.45
50-54	*M*	3.38	3.23	3.46	3.37	3.35
	SD	.54	.56	.46	.49	0.46
55-59	*M*	3.37	3.19	3.45	3.39	3.34
	SD	.51	.52	.44	.42	0.41
60-64	*M*	3.43	3.29	3.53	3.51	3.45
	SD	.50	.53	.39	.43	0.40
65-69	*M*	3.39	3.33	3.43	3.51	3.43
	SD	.83	.71	.77	.70	0.70
>69	*M*	3.67	2.86	3.30	3.44	3.32
	SD	-	-	-	-	.

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J11

ANOVA for Overall Teacher Self-Efficacy Means Based on Age of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.82	10	.28	1.30	.22**
Within Groups	245.80	1137	.220		
Total	248.61	1147			

Note. **Significance at the $p<.05$ level.

Table J12

Frequency Distribution Based on Residence of PLTW Teachers

State of Residence	*N*	%
AK	2	0.17
AL	3	0.26
AR	4	0.35
AZ	11	0.96
CA	61	5.32
CO	21	1.83
CT	13	1.13
DC	5	0.44
FL	25	2.18
HI	1	0.09
IA	48	4.18
ID	5	0.44
IL	39	3.40
IN	82	7.15
KS	20	1.74
KY	19	1.66
GA	5	0.44
LA	13	1.13
MA	5	0.44
MD	52	4.53
ME	1	0.09
MI	22	1.92
MN	50	4.36
MO	52	4.53
MS	1	0.09
MT	2	0.17
NC	30	2.62
ND	1	0.09
NE	1	0.09
NH	12	1.05
NJ	20	1.74
NM	8	0.70
NV	3	0.26
NY	89	7.76
OH	67	5.84
OK	26	2.27
OR	13	1.13
PA	23	2.01
SC	48	4.18
SD	2	0.17
TN	10	0.87

(Continued)

Table J12 *Continued*

State of Residence	*N*	%
TX	86	7.50
UT	12	1.05
VA	15	1.31
VT	2	0.17
WA	20	1.74
WI	84	7.32
WV	8	0.70
WY	2	0.17
Number of Respondents	1143	100.00
Number of Non-Respondents	14	

Table J13

Residence of PLTW Teachers: Five States with the Highest Teacher Self-Efficacy Means

State:		MLR	AID	CC	MFL	OSE
NJ	*M*	3.36	3.50	3.62	3.54	3.53
	SD	0.59	0.38	0.27	0.39	0.34
	N	20	20	20	20	20
AZ	*M*	3.44	3.55	3.58	3.49	3.52
	SD	.41	.43	.39	.47	.38
	N	11	11	11	11	11
FL	*M*	3.42	3.40	3.54	3.53	3.51
	SD	.48	.53	.39	.40	.38
	N	25	25	25	25	25
NY	*M*	3.39	3.51	3.61	3.50	3.50
	SD	0.55	0.49	0.37	0.45	0.41
	N	89	89	89	89	89
MD	*M*	3.29	3.56	3.63	3.57	3.49
	SD	.51	.49	.38	.38	.37
	N	52	52	52	52	52

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J14

Residence of PLTW Teachers: Five States with the Lowest Teacher Self-Efficacy Means

State:		MLR	AID	CC	MFL	OSE
LA	*M*	3.05	3.08	3.12	3.18	3.12
	SD	.43	.64	.47	.36	.36
	N	13	13	13	13	13
TN	*M*	2.60	3.23	3.42	3.21	3.12
	SD	.55	.50	.40	.49	.43
	N	10	10	10	10	10
KY	*M*	2.89	3.09	3.31	3.18	3.13
	SD	.48	.61	.41	.51	.44
	N	19	19	19	19	19
UT	*M*	2.94	3.11	3.28	3.23	3.13
	SD	.51	.52	.45	.47	.43
	N	12	12	12	12	12
MI	*M*	3.06	3.12	3.22	3.12	3.14
	SD	.49	.49	.46	.51	.43
	N	22	22	22	22	22

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J15
Self-Efficacy Means Based on Residence of PLTW Teachers

State:		MLR	AID	CC	MFL	OSE
AK	*M*	3.43	3.50	3.70	3.39	3.53
	SD	.20	.71	.42	.55	.34
	N	2	2	2	2	2
AL	*M*	2.95	3.22	3.47	3.44	3.33
	SD	.95	.84	.50	.56	.58
	N	3	3	3	3	3
AR	*M*	2.75	2.92	3.18	3.19	3.07
	SD	.24	.17	.15	.45	.20
	N	4	4	4	4	4
AZ	*M*	3.44	3.55	3.58	3.49	3.52
	SD	.41	.43	.39	.47	.38
	N	11	11	11	11	11
CA	*M*	3.18	3.41	3.42	3.38	3.32
	SD	.46	.47	.40	.44	.39
	N	61	61	61	61	61
CO	*M*	3.27	3.46	3.43	3.35	3.35
	SD	.56	.54	.49	.43	.46
	N	21	21	21	21	21
CT	*M*	3.10	3.33	3.40	3.40	3.31
	SD	.65	.53	.39	.48	.44
	N	13	13	13	13	13
DC	*M*	2.74	3.00	3.06	2.96	2.90
	SD	.84	1.11	.90	.66	.70
	N	5	5	5	5	5
FL	*M*	3.42	3.40	3.54	3.53	3.51
	SD	.48	.53	.39	.40	.38
	N	25	25	25	25	25
GA	*M*	3.29	3.33	3.58	3.40	3.42
	SD	.78	.71	.46	.60	.65
	N	5	5	5	5	5

(Continued)

Table J15 *Continued*

State:		MLR	AID	CC	MFL	OSE
HI	*M*	4.00	4.00	4.00	4.00	4.00
	SD	.	.	.	.	.
	N	1	1	1	1	1
IA	*M*	3.18	3.38	3.48	3.40	3.37
	SD	.52	.55	.46	.44	.41
	N	48	48	48	48	48
ID	*M*	2.94	3.33	3.36	3.27	3.21
	SD	.67	.53	.37	.23	.35
	N	5	5	5	5	5
IL	*M*	3.23	3.44	3.52	3.38	3.37
	SD	.64	.61	.56	.57	.56
	N	39	39	39	39	39
IN	*M*	3.07	3.27	3.37	3.24	3.22
	SD	.59	.64	.54	.55	.53
	N	82	82	82	82	82
KS	*M*	3.23	3.47	3.46	3.32	3.32
	SD	.48	.55	.44	.44	.45
	N	20	20	20	20	20
KY	*M*	2.89	3.09	3.31	3.18	3.13
	SD	.48	.61	.41	.51	.44
	N	19	19	19	19	19
LA	*M*	3.05	3.08	3.12	3.18	3.12
	SD	.43	.64	.47	.36	.36
	N	13	13	13	13	13
MA	*M*	2.54	3.07	3.08	2.93	2.93
	SD	.90	1.04	.93	.94	.86
	N	5	5	5	5	5

(Continued)

Table J15 *Continued*

State:		MLR	AID	CC	MFL	OSE
MD	*M*	3.29	3.56	3.63	3.57	3.49
	SD	.51	.49	.38	.38	.37
	N	52	52	52	52	52
ME	*M*	3.29	3.00	2.70	2.78	2.90
	SD	.	.	.	.	.
	N	1	1	1	1	1
MH	*M*	3.14	4.00	4.00	3.33	3.58
	SD	.	.	.	.	.
	N	1	1	1	1	1
MI	*M*	3.06	3.12	3.22	3.12	3.14
	SD	.49	.49	.46	.51	.43
	N	22	22	22	22	22
MN	*M*	3.13	3.29	3.41	3.26	3.26
	SD	.56	.61	.47	.50	.47
	N	50	50	50	50	50
MO	*M*	3.25	3.39	3.49	3.42	3.38
	SD	.58	.62	.53	.57	.53
	N	52	52	52	52	52
MS	*M*	3.00	3.00	3.00	2.78	2.94
	SD	.	.	.	.	.
	N	1	1	1	1	1
MT	*M*	3.79	4.00	3.95	3.94	3.92
	SD	.30	.00	.07	.08	.11
	N	2	2	2	2	2
NC	*M*	3.15	3.39	3.54	3.47	3.40
	SD	.48	.45	.38	.39	.37
	N	30	30	30	30	30
ND	*M*	3.29	4.00	3.80	3.89	3.61
	SD	.	.	.	.	.
	N	1	1	1	1	1
NE	*M*	3.00	3.67	3.60	3.44	3.35
	SD	.	.	.	.	.
	N	1	1	1	1	1

(Continued)

Table J15 *Continued*

State:		MLR	AID	CC	MFL	OSE
NH	*M*	3.37	3.42	3.53	3.30	3.37
	SD	.51	.71	.34	.47	.40
	N	12	12	12	12	12
NJ	*M*	3.36	3.50	3.62	3.54	3.53
	SD	0.59	0.38	0.27	0.39	0.34
	N	20	20	20	20	20
NM	*M*	3.09	3.08	3.30	3.07	3.15
	SD	0.60	0.71	0.53	0.67	0.58
	N	8	8	8	8	8
NV	*M*	3.71	3.67	3.67	3.70	3.68
	SD	0.49	0.58	0.31	0.51	0.40
	N	3	3	3	3	3
NY	*M*	3.39	3.51	3.61	3.50	3.50
	SD	0.55	0.49	0.37	0.45	0.41
	N	89	89	89	89	89
OH	*M*	3.20	3.32	3.44	3.38	3.34
	SD	0.56	0.58	0.50	0.51	0.48
	N	67	67	67	67	67
OK	*M*	3.09	3.42	3.42	3.35	3.29
	SD	0.49	0.56	0.45	0.40	0.38
	N	26	26	26	26	26
OR	*M*	3.10	3.21	3.21	3.24	3.15
	SD	0.73	0.76	0.63	0.62	0.62
	N	13	13	13	13	13
PA	*M*	3.17	3.49	3.60	3.37	3.40
	SD	0.50	0.40	0.35	0.45	0.39
	N	23	23	23	23	23
SC	*M*	3.33	3.49	3.56	3.45	3.45
	SD	0.53	0.55	0.44	0.43	0.42
	N	48	48	48	48	48

(Continued)

Table J15 *Continued*

State:		MLR	AID	CC	MFL	OSE
SD	*M*	3.29	3.83	3.50	3.44	3.35
	SD	0.20	0.24	0.28	0.47	0.36
	N	2	2	2	2	2
TN	*M*	2.60	3.23	3.42	3.21	3.12
	SD	.55	.50	.40	.49	.43
	N	10	10	10	10	10
TX	*M*	3.24	3.35	3.45	3.37	3.35
	SD	.57	.60	.50	.54	.50
	N	86	86	86	86	86
UT	*M*	2.94	3.11	3.28	3.23	3.13
	SD	.51	.52	.45	.47	.43
	N	12	12	12	12	12
VA	*M*	3.07	3.31	3.33	3.33	3.24
	SD	.45	.44	.36	.48	.36
	N	15	15	15	15	15
VT	*M*	4.00	4.00	4.00	3.94	3.98
	SD	.00	.00	.00	.08	.02
	N	2	2	2	2	2
WA	*M*	2.99	3.27	3.37	3.25	3.20
	SD	.70	.48	.44	.41	.40
	N	20	20	20	20	20
WI	*M*	3.14	3.32	3.41	3.29	3.29
	SD	.60	.58	.50	.52	.49
	N	84	84	84	84	84
WV	*M*	2.79	2.75	2.91	2.83	2.85
	SD	.83	.75	.81	.87	.80
	N	8	8	8	8	8
WY	*M*	2.86	3.33	3.45	3.11	3.15
	SD	.20	.00	.07	.16	.16
	N	2	2	2	2	2

Table J16

Frequency Distribution Based on Teaching Experience of PLTW Teachers

Dimension	Mean	*SD*	*N*	%
Teaching Experience in Years (1-45 years)	14.37	9.36		
1-4			141	12.34
5-9			293	25.63
10-14			218	19.07
15-19			172	15.05
20-24			131	11.46
35-29			97	8.49
30-34			48	4.20
35-39			32	2.80
40-44			10	0.87
45-50			1	0.09
Number of Respondents			1143	100.00
Number of Non-Respondents			14	

Table J17

Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers (n = 1143)

Years		AID	MLR	CC	MFL	OSE
1-4	*M*	2.98	3.17	3.28	3.21	3.17
	SD	0.57	0.59	0.50	0.50	0.47
5-9	*M*	3.14	3.34	3.42	3.33	3.30
	SD	0.55	0.57	0.46	0.49	0.46
10-14	*M*	3.25	3.41	3.50	3.40	3.39
	SD	0.58	0.58	0.48	0.52	0.48
15-19	*M*	3.23	3.40	3.47	3.39	3.36
	SD	0.56	0.56	0.46	0.48	0.45
20-24	*M*	3.29	3.45	3.54	3.42	3.40
	SD	0.52	0.51	0.41	0.45	0.42
25-29	*M*	3.23	3.41	3.51	3.41	3.38
	SD	0.59	0.57	0.50	0.54	0.51
30-34	*M*	3.27	3.44	3.58	3.41	3.42
	SD	0.55	0.52	0.39	0.44	0.41

(Continued)

Table J17 *Continued*

Years		AID	MLR	CC	MFL	OSE
35-39	*M*	3.30	3.32	3.43	3.36	3.36
	SD	0.60	0.70	0.57	0.59	0.57
40-44	*M*	3.11	3.33	3.42	3.50	3.36
	SD	0.55	0.47	0.46	0.29	0.35
>44	*M*	3.14	3.33	3.70	3.78	3.61
	SD	-	-	-	-	-

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J18
ANOVA for Overall Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	6.30	9	.70	3.24	.001**
Within Groups	243.14	1133	.22		
Total	249.40	1142			

Note. **Significance at the $p<.05$ level.

Table J19
ANOVA for (Monitoring and Feedback for Learning) Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	5.32	9	.59	2.41	.011**
Within Groups	278.42	1133	.25		
Total	283.73	1142			

Note. **Significance at the $p<.05$ level.

Table J20
ANOVA for (Maintaining a Positive Classroom Climate) Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	7.083	9	.79	3.61	.000**
Within Groups	246.82	1133	.22		
Total	253.90	1142			

Note. **Significance at the $p<.05$ level.

Table J21

ANOVA for (Managing Learning Routine) Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	7.40	9	.82	2.55	.007**
Within Groups	365.38	1133	.32		
Total	372.78	1142			

Note. **Significance at the $p<.05$ level.

Table J22

ANOVA for (Accommodating Individual Differences) Teacher Self-Efficacy Means Based on Teaching Experience of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	10.64	9	1.18	3.75	.000**
Within Groups	357.11	1133	.32		
Total	367.74	1142			

Note. **Significance at the $p<.05$ level.

Table J23

Frequency Distribution Based on School Setting of PLTW Teachers

Dimension	*N*	%
School Setting		
Public	1109	96.27
Private Non-Parochial	2	0.17
Private Parochial	16	1.39
Charter	16	1.39
Other	9	0.78
Number of Respondents	1152	100.00
Number of Non-Respondents	5	

Table J24

Teacher Self-Efficacy Means Based on School Setting of PLTW Teachers (n = 1152)

School Setting		AID	MLR	CC	MFL	OSE
Public	*M*	3.20	3.36	3.46	3.36	3.34
	SD	.57	.57	.47	.50	.47
Private Non-Parochial	*M*	3.43	3.33	3.45	3.44	3.47
	SD	.81	.94	.78	.79	.62
Private Parochial	*M*	2.89	3.27	3.32	3.18	3.15
	SD	.60	.71	.55	.45	.45
Charter	*M*	2.97	3.50	3.51	3.43	3.33
	SD	.60	.54	.39	.38	.37
Other	*M*	3.21	3.56	3.54	3.51	3.48
	SD	.62	.47	.46	.49	.45

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J25

ANOVA for Overall Teacher Self-Efficacy Means Based on School Setting of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.76	4	.19	.87	.481**
Within Groups	250.25	1147	.22		
Total	251.01	1151			

Note. **Significance at the $p<.05$ level.

Table J26

Frequency Distribution of Additional PLTW Teachers Employed at Current School

Additional PLTW Teachers in School	*N*	%
0	283	24.52
1	329	28.51
2	260	22.53
3	144	12.48
4	67	5.81
5	30	2.60
6	16	1.39
7	3	0.26
8	4	0.35
9	3	0.26
10	2	0.17
>10	13	1.13
Number of Respondents	1154	100.00
Number of Non-Respondents	3	

Table J27

Teacher Self-Efficacy Means Based on Additional PLTW Teachers in the School (n = 1154)

# of PLTW teachers		AID	MLR	CC	MFL	OSE
0	*M*	3.17	3.33	3.40	3.31	3.29
	SD	.56	.57	.49	.53	.48
1	*M*	3.19	3.33	3.44	3.36	3.33
	SD	.58	.61	.49	.50	.48
2	*M*	3.21	3.38	3.47	3.38	3.35
	SD	.56	.57	.44	.48	.45
3	*M*	3.15	3.39	3.45	3.35	3.32
	SD	.57	.53	.46	.45	.45
4	*M*	3.17	3.44	3.50	3.39	3.36
	SD	.61	.54	.50	.52	.49
5	*M*	3.27	3.58	3.63	3.51	3.48
	SD	.53	.50	.44	.54	.47
6	*M*	3.51	3.60	3.74	3.60	3.62
	SD	.55	.53	.39	.46	.42
7	*M*	2.95	3.33	3.50	3.15	3.20
	SD	.16	.33	.26	.06	.13
8	*M*	2.86	3.25	3.38	3.19	3.17
	SD	.29	.32	.21	.43	.16
9	*M*	3.00	3.11	3.37	3.22	3.30
	SD	.43	.19	.23	.44	.35
10	*M*	3.64	3.83	3.80	3.56	3.65
	SD	.51	.24	.28	.63	.50
>10	*M*	3.42	3.54	3.62	3.56	3.52
	SD	.38	.42	.31	.32	.29

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J28

ANOVA for Overall Teacher Self-Efficacy Means Based on Additional PLTW Teachers in the School

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.51	11	.32	1.47	.14**
Within Groups	247.77	1142	.22		
Total	251.28	1153			

Note. **Significance at the $p<.05$ level.

Table J29

Frequency Distribution Based on Licensure Process of PLTW Teachers

Teaching Licensure Process	*N*	%
Does not hold a teaching license nor working toward a teaching license	11	0.96
Does not hold a teaching license but working toward a teaching license	18	1.57
Holds a teaching license after earning a degree in an educational field	870	75.72
Holds a teaching license but does not have a degree in an educational field	250	21.76
Number of Respondents	1149	100.00
Number of Non-Respondents	7	

Table J30

Teacher Self-Efficacy Means Based on Licensure Process of PLTW Teachers (n = 1149)

Method of licensure		AID	MLR	CC	MFL	OAS
Does not hold a teaching license and is not working on obtaining a license.	*M*	2.71	3.09	3.15	3.19	3.06
	SD	.55	.58	.47	.53	.47
Does not hold a teaching license but is working on obtaining a license.	*M*	2.83	3.13	3.19	3.06	3.04
	SD	.51	.54	.47	.42	.43
Holds a teaching license after earning a degree in an educational field	*M*	3.21	3.37	3.47	3.36	3.34
	SD	.57	.58	.48	.51	.47
Holds a teaching license, but did not earn an degree in an educational field	*M*	3.15	3.38	3.44	3.38	3.34
	SD	.56	.55	.43	.47	.43

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J31

ANOVA for Overall Teacher Self-Efficacy Means Based on Licensure Process of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.51	3	.84	3.87	.009**
Within Groups	247.72	1145	.22		
Total	250.23	1148			

Note. **Significance at the p<.05 level.

Table J32

ANOVA for (Monitoring and Feedback for Learning) Teacher Self-Efficacy Means Based on Licensure Process of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.03	3	.68	2.75	.042**
Within Groups	281.88	1145	.25		
Total	283.91	1148			

Note. **Significance at the p<.05 level.

Table J33

ANOVA for (Maintaining a Positive Classroom Climate) Teacher Self-Efficacy Means Based Licensure Process of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.45	3	.82	3.70	.011**
Within Groups	252.87	1145	.22		
Total	255.32	1148			

Note. **Significance at the p<.05 level.

Table J34

ANOVA for (Managing Learning Routine) Teacher Self-Efficacy Means Based Licensure Process of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.90	3	.64	1.96	.119**
Within Groups	372.34	1145	.33		
Total	374.25	1148			

Note. **Significance at the p<.05 level.

Table J35

ANOVA for (Accommodating Individual Differences) Teacher Self-Efficacy Means Based Licensure Process of PLTW Teachers

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	5.58	3	1.86	5.85	.001**
Within Groups	364.15	1145	.32		
Total	369.74	1148			

Note. **Significance at the $p<.05$ level.

Table J36

Frequency Distribution Based on Post-Secondary Degrees Completed

Post-Secondary Degrees Completed	*N*	%
Math Education		
Bachelor's Degree	92	4.32
Master's Degree	37	1.74
PhD. Degree	1	0.05
Science Education		
Bachelor's Degree	91	4.27
Master's Degree	60	2.82
PhD. Degree	0	0.00
Technology Education		
Bachelor's Degree	413	19.39
Master's Degree	194	9.11
PhD. Degree	1	0.05
PhD. Degree	2	0.09
Engineering Education		
Bachelor's Degree	51	2.39
Master's Degree	13	0.61
Math Non-Education		
Bachelor's Degree	34	1.60
Master's Degree	13	0.61
PhD. Degree	1	0.05
Science Non-Education		
Bachelor's Degree	91	4.27
Master's Degree	20	0.94
PhD. Degree	1	0.05
Engineering		
Bachelor's Degree	166	7.79
Master's Degree	42	1.97
PhD. Degree	4	0.19

(Continued)

Table J36 *Continued*

Post-Secondary Degrees Completed	*N*	%
Education		
Bachelor's Degree	133	6.24
Master's Degree	279	13.10
PhD. Degree	4	0.19
Other		
Bachelor's Degree	232	10.89
Master's Degree	149	7.00
PhD. Degree	6	0.28
Total Degrees Awarded	2130	
Number of Respondents	1134	100.00
Number of Non-Respondents	23	

Table J37

Teacher Self-Efficacy Means Based on Completed Bachelor Degrees

Bachelor's Degree		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.20	3.38	3.47	3.42	3.37
	SD	.55	.55	.46	.43	.42
	N	92	92	92	92	92
Science Education	*M*	3.15	3.38	3.42	3.38	3.32
	SD	.60	.58	.48	.49	.48
	N	90	90	90	90	90
Technology Education	*M*	3.20	3.37	3.48	3.35	3.34
	SD	.57	.58	.50	.52	.49
	N	410	410	410	410	410
Engineering Education	*M*	3.29	3.39	3.47	3.38	3.38
	SD	.63	.54	.47	.50	.50
	N	50	50	50	50	50
Math Non-Education	*M*	3.13	3.32	3.39	3.39	3.31
	SD	.60	.61	.50	.48	.47
	N	33	33	33	33	33
Science Non-Education	*M*	3.29	3.46	3.50	3.42	3.41
	SD	.57	.61	.47	.50	.48
	N	90	90	90	90	90
Engineering	*M*	3.08	3.31	3.38	3.33	3.28
	SD	.56	.55	.44	.50	.44
	N	163	163	163	163	163
Education	*M*	3.29	3.43	3.50	3.39	3.39
	SD	.55	.56	.48	.53	.49
	N	133	133	133	133	133
Other	*M*	3.23	3.34	3.46	3.38	3.35
	SD	.56	.55	.44	.48	.45
	N	231	231	231	231	231

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J38

ANOVA for Overall Teacher Self-Efficacy Means Based on Completed Bachelor Degrees

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.01	7	.29	1.32	.236**
Within Groups	249.75	1149	.22		
Total	251.77	1156			

Note. **Significance at the $p<.05$ level.

Table J39

Teacher Self-Efficacy Means Based on Completed Master's Degrees

Master's Degree		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.25	3.45	3.51	3.43	3.40
	SD	.60	.49	.39	.42	.39
	N	37	37	37	37	37
Science Education	*M*	3.25	3.39	3.45	3.40	3.36
	SD	.48	.50	.38	.46	.39
	N	60	60	60	60	60
Technology Education	*M*	3.22	3.35	3.48	3.35	3.35
	SD	.57	.58	.49	.54	.50
	N	192	192	192	192	192
Engineering Education	*M*	3.16	3.28	3.25	3.21	3.18
	SD	.59	.56	.49	.52	.49
	N	13	13	13	13	13
Math Non-Education	*M*	3.48	3.69	3.68	3.65	3.61
	SD	.40	.37	.33	.34	.34
	N	13	13	13	13	13
Science Non-Education	*M*	3.15	3.28	3.28	3.28	3.22
	SD	.48	.64	.55	.48	.49
	N	20	20	20	20	20
Engineering	*M*	3.12	3.50	3.47	3.45	3.36
	SD	.61	.48	.37	.46	.43
	N	41	41	41	41	41
Education	*M*	3.28	3.44	3.51	3.43	3.40
	SD	.58	.57	.47	.50	.48
	N	277	277	277	277	277
Other	*M*	3.23	3.47	3.56	3.41	3.40
	SD	.60	.56	.46	.48	.46
	N	148	148	148	148	148

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J40
ANOVA for Overall Teacher Self-Efficacy Means Based on Based on Completed Master's Degrees

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	4.33	8	.54	2.51	.011**
Within Groups	247.44	1148	.22		
Total	251.77	1156			

Note. **Significance at the $p<.05$ level.

Table J41
Teacher Self-Efficacy Means Based on PLTW Teacher with a Bachelor's Degree and a Completed Master's Degree in Education

Bachelor's Degree		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.19	3.40	3.53	3.49	3.41
	SD	.55	.55	.44	.41	.42
	N	27	27	27	27	27
Science Education	*M*	3.37	3.67	3.66	3.61	3.54
	SD	.59	.49	.36	.38	.39
	N	25	25	25	25	25
Technology Education	*M*	3.32	3.44	3.54	3.42	3.42
	SD	.61	.60	.52	.54	.52
	N	104	104	104	104	104
Engineering Education	*M*	3.39	3.40	3.50	3.42	3.43
	SD	.50	.41	.41	.41	.41
	N	10	10	10	10	10
Math Non-Education	*M*	2.86	3.39	3.43	3.35	3.19
	SD	.81	.53	.50	.36	.49
	N	6	6	6	6	6
Science Non-Education	*M*	3.25	3.28	3.43	3.40	3.36
	SD	.71	.77	.60	.58	.60
	N	27	27	27	27	27
Engineering	*M*	3.34	3.46	3.49	3.44	3.43
	SD	.56	.53	.48	.53	.51
	N	31	31	31	31	31
Education	*M*	3.37	3.59	3.61	3.40	3.44
	SD	.49	.45	.38	.46	.43
	N	33	33	33	33	33
Other	*M*	3.28	3.40	3.49	3.45	3.41
	SD	.60	.56	.50	.55	.50
	N	57	57	57	57	57

(Continued)

Table J41 *Continued*

Bachelor's Degree		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.19	3.40	3.53	3.49	3.41
	SD	.55	.55	.44	.41	.42
	N	27	27	27	27	27

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J42

ANOVA for Overall Teacher Self-Efficacy Means Based on Bachelor's Degree and a Completed Master's Degree in Education

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.23	5	.25	1.07	.377**
Within Groups	62.54	273	.23		
Total	63.77	278			

Note. **Significance at the $p<.05$ level.

Table J43

Teacher Self-Efficacy Means Based on PLTW Teacher with a Bachelor's Degree and a Completed Master's Degree in Technology Education

Bachelor's Degree		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.39	3.57	3.60	3.46	3.50
	SD	.46	.57	.50	.51	.46
	N	7	7	7	7	7
Science Education	*M*	2.75	3.17	3.15	3.08	3.05
	SD	1.31	1.45	1.44	1.42	1.38
	N	4	4	4	4	4
Technology Education	*M*	3.23	3.38	3.51	3.35	3.36
	SD	.57	.57	.47	.52	.49
	N	108	108	108	108	108
Engineering Education	*M*	3.37	3.48	3.60	3.33	3.37
	SD	.67	.63	.43	.54	.57
	N	7	7	7	7	7
Math Non-Education	*M*	3.38	3.33	3.77	3.74	3.66
	SD	.58	.67	.21	.45	.39
	N	3	3	3	3	3
Science Non-Education	*M*	3.14	3.33	3.38	3.19	3.23
	SD	.61	.47	.45	.55	.51
	N	4	4	4	4	4

(Continued)

Table J43 *Continued*

Bachelor's Degree		AID	MLR	CC	MFL	OAS
Engineering	*M*	3.12	3.03	3.19	3.18	3.17
	SD	.59	.67	.49	.60	.52
	N	12	12	12	12	12
Education	*M*	3.37	3.39	3.51	3.38	3.42
	SD	.50	.46	.40	.47	.44
	N	24	24	24	24	24
Other	*M*	3.20	3.37	3.53	3.37	3.35
	SD	.51	.48	.35	.44	.40
	N	35	35	35	35	35

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J44

ANOVA for Overall Teacher Self-Efficacy Means Based on Bachelor's Degree and a Completed Master's Degree in Technology Education

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.77	5	.15	.61	.694**
Within Groups	47.44	188	.25		
Total	48.21	193			

Note. **Significance at the $p<.05$ level.

Table J45

Frequency Distribution Based Post-Secondary Degrees in Progress

Post-Secondary Degrees in Progress	*N*	%
Math Education		
Bachelor's Degree	4	1.40
Master's Degree	8	2.81
PhD. Degree	1	0.35
Science Education		
Bachelor's Degree	3	1.05
Master's Degree	16	5.61
PhD. Degree	3	1.05
Technology Education		
Bachelor's Degree	13	4.56
Master's Degree	43	15.09
PhD. Degree	8	2.81
Engineering Education		
Bachelor's Degree	12	4.21
Master's Degree	12	4.21
PhD. Degree	0	0.00

(Continued)

Table J45 *Continued*

Post-Secondary Degrees in Progress	*N*	%
Math Non-Education		
Bachelor's Degree	2	0.70
Master's Degree	0	0.00
PhD. Degree	0	0.00
Science Non-Education		
Bachelor's Degree	3	1.05
Master's Degree	2	0.70
PhD. Degree	3	1.05
Engineering		
Bachelor's Degree	11	3.86
Master's Degree	5	1.75
PhD. Degree	2	0.70
Education		
Bachelor's Degree	7	2.46
Master's Degree	47	16.49
PhD. Degree	15	5.26
Other		
Bachelor's Degree	17	5.96
Master's Degree	38	13.33
PhD. Degree	10	3.51
Total Degrees in Progress	285	
Number of Respondents	248	
Number of Non-Respondents	909	

Table J46

Frequency Distribution Based on Teaching Endorsement

Teaching Endorsement by Grade Level	*N*	%
Math Education		
K-5	73	2.19
6-8	216	6.47
9-12	265	7.94
Science Education		
K-5	72	2.16
6-8	199	5.96
9-12	237	7.10
Technology Education		
K-5	276	8.27
6-8	538	16.12
9-12	671	20.11
STEM Education		
K-5	23	0.69
6-8	93	2.79
9-12	155	4.64
Other		
K-5	106	3.18
6-8	178	5.33
9-12	235	7.04
Total Endorsements	3337	
Number of Respondents	1157	
Number of Non-Respondents	0	

Table J47

Teacher Self-Efficacy Means Based on Teaching Endorsements (n = 1157)

Endorsements		AID	MLR	CC	MFL	OAS
Math Education	*M*	3.32	3.46	3.55	3.48	3.46
K-5	*SD*	.54	.51	.38	.44	.41
Math Education	*M*	3.18	3.37	3.45	3.40	3.34
6-8	*SD*	.55	.52	.43	.45	.43
Math Education	*M*	3.14	3.37	3.43	3.39	3.33
9-12	*SD*	.58	.56	.48	.49	.47
Science Education	*M*	3.33	3.48	3.53	3.47	3.44
K-5	*SD*	.51	.50	.38	.43	.40
Science Education	*M*	3.25	3.44	3.49	3.43	3.39
6-8	*SD*	.54	.53	.42	.45	.43
Science Education	*M*	3.18	3.36	3.41	3.37	3.32
9-12	*SD*	.59	.61	.49	.52	.49
Technology Education	*M*	3.25	3.40	3.52	3.39	3.39
K-5	*SD*	.56	.54	.45	.50	.46

(Continued)

Table J47 *Continued*

Endorsements		AID	MLR	CC	MFL	OAS
Technology Education	*M*	3.24	3.40	3.50	3.38	3.37
6-8	*SD*	.55	.54	.44	.48	.45
Technology Education	*M*	3.23	3.40	3.50	3.38	3.37
9-12	*SD*	.56	.55	.46	.49	.46
STEM Education	*M*	3.47	3.59	3.61	3.48	3.51
K-5	*SD*	.50	.48	.45	.49	.45
STEM Education	*M*	3.35	3.50	3.52	3.44	3.43
6-8	*SD*	.53	.48	.43	.47	.44
STEM Education	*M*	3.21	3.38	3.44	3.36	3.35
9-12	*SD*	.60	.59	.55	.55	.52
Other Education	*M*	3.34	3.44	3.52	3.44	3.42
K-5	*SD*	.51	.53	.43	.43	.41
Other Education	*M*	3.26	3.38	3.48	3.38	3.37
6-8	*SD*	.50	.52	.42	.45	.41
Other Education	*M*	3.24	3.37	3.48	3.36	3.36
9-12	*SD*	.52	.52	.42	.47	.42

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J48

Frequency Distribution Based on Post-Secondary Hours Completed

Hours Completed	*N*	%
Mathematics		
0	431	40.62
1-3	53	5.00
4-6	114	10.74
7-9	65	6.13
10-12	94	8.86
13-15	41	3.86
16-18	52	4.90
19-21	28	2.64
22-24	24	2.26
>24	159	14.99

(Continued)

Table J48 *Continued*

Hours Completed	*N*	%
Math Education		
0	809	76.25
1-3	54	5.09
4-6	47	4.43
7-9	21	1.98
10-12	33	3.11
13-15	16	1.51
16-18	15	1.41
19-21	9	0.85
22-24	7	0.66
>24	50	4.71
Science		
0	487	45.90
1-3	34	3.20
4-6	63	5.94
7-9	73	6.88
10-12	86	8.11
13-15	39	3.68
16-18	52	4.90
19-21	19	1.79
22-24	24	2.26
Science Education		
0	820	77.29
1-3	38	3.58
4-6	49	4.62
7-9	18	1.70
10-12	37	3.49
13-15	21	1.98
16-18	19	1.79
19-21	7	0.66
22-24	6	0.57

(Continued)

Table J48 *Continued*

Hours Completed	*N*	%
Technology		
0	501	47.22
1-3	55	5.18
4-6	78	7.35
7-9	35	3.30
10-12	77	7.26
13-15	34	3.20
16-18	33	3.11
19-21	22	2.07
22-24	15	1.41
>24	211	19.89
Technology Education		
0	471	44.39
1-3	57	5.37
4-6	65	6.13
7-9	32	3.02
10-12	52	4.90
13-15	14	1.32
16-18	26	2.45
19-21	25	2.36
22-24	20	1.89
>24	299	28.18
Engineering		
0	528	49.76
1-3	70	6.60
4-6	88	8.29
7-9	36	3.39
10-12	68	6.41
13-15	25	2.36
16-18	25	2.36
19-21	13	1.23
22-24	13	1.23
>24	195	18.38

(Continued)

Table J48 *Continued*

Hours Completed	*N*	%
Vocational T&I Education		
0	746	70.31
1-3	32	3.02
4-6	38	3.58
7-9	27	2.54
10-12	33	3.11
13-15	15	1.41
16-18	26	2.45
19-21	8	0.75
22-24	14	1.32
>24	122	11.50
Curriculum and Instruction		
0	417	39.30
1-3	37	3.49
4-6	92	8.67
7-9	56	5.28
10-12	96	9.05
13-15	45	4.24
16-18	41	3.86
19-21	29	2.73
22-24	36	3.39
>24	212	19.98
Number of Respondents	1061	
Number of Non-Respondents	96	

Table J49

Teacher Self-Efficacy Means Based on Post-Secondary Math Credits Hours (n = 672)

Credit Hours		AID	MLR	CCM	MFL	OSE
0	*M*	3.11	3.20	3.31	3.20	3.20
	SD	.75	.78	.71	.69	.68
1-3	*M*	3.20	3.41	3.45	3.35	3.33
	SD	.56	.56	.45	.51	.47
4-6	*M*	3.17	3.37	3.44	3.33	3.31
	SD	.57	.56	.48	.54	.49
7-9	*M*	3.20	3.30	3.45	3.33	3.33
	SD	.54	.61	.51	.46	.45
10-12	*M*	3.18	3.33	3.43	3.35	3.32
	SD	.57	.61	.48	.50	.47
13-15	*M*	3.29	3.48	3.58	3.47	3.45
	SD	.50	.52	.38	.43	.39
16-18	*M*	3.31	3.53	3.57	3.47	3.45
	SD	.57	.48	.40	.45	.44
19-21	*M*	3.16	3.18	3.32	3.20	3.23
	SD	.38	.47	.38	.43	.36
22-24	*M*	3.08	3.29	3.45	3.41	3.32
	SD	.63	.64	.49	.51	.48
More than	*M*	3.21	3.43	3.48	3.44	3.38
24	*SD*	.58	.53	.44	.46	.44

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J50

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Math Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.73	9	.30	1.36	.202**
Within Groups	147.25	662	.22		
Total	149.98	671			

Note. **Significance at the p<.05 level.

Table J51

Teacher Self-Efficacy Means Based on Post-Secondary Math Education Credits Hours (n = 381)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.20	3.36	3.45	3.34	3.32
	SD	.61	.64	.52	.54	.52
1-3	*M*	3.21	3.40	3.44	3.34	3.33
	SD	.58	.60	.47	.52	.48
4-6	*M*	3.16	3.40	3.47	3.37	3.34
	SD	.63	.63	.46	.50	.47
7-9	*M*	3.28	3.48	3.47	3.46	3.40
	SD	.45	.43	.37	.44	.36
10-12	*M*	3.09	3.17	3.28	3.18	3.18
	SD	.66	.76	.68	.63	.63
13-15	*M*	3.25	3.54	3.59	3.56	3.47
	SD	.53	.47	.40	.45	.39
16-18	*M*	3.20	3.40	3.50	3.47	3.41
	SD	.60	.52	.42	.42	.43
19-21	*M*	3.40	3.59	3.52	3.46	3.45
	SD	.62	.43	.45	.37	.35
22-24	*M*	3.47	3.43	3.46	3.48	3.48
	SD	.48	.63	.54	.69	.53
More than	*M*	3.29	3.41	3.52	3.48	3.44
24	*SD*	.56	.50	.41	.42	.42

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J52

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Math Education Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.024	9	.23	.95	.485**
Within Groups	88.158	371	.24		
Total	90.181	380			

Note. **Significance at the $p<.05$ level.

Table J53

Teacher Self-Efficacy Means Based on Post-Secondary Science Credits Hours (n = 619)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.15	3.27	3.34	3.27	3.24
	SD	.68	.71	.63	.61	.60
1-3	*M*	3.29	3.39	3.52	3.44	3.42
	SD	.70	.62	.54	.60	.57
4-6	*M*	3.19	3.35	3.46	3.33	3.32
	SD	.54	.54	.49	.54	.49
7-9	*M*	3.08	3.27	3.40	3.30	3.26
	SD	.62	.60	.51	.50	.48
10-12	*M*	3.32	3.43	3.56	3.48	3.46
	SD	.51	.58	.43	.44	.42
13-15	*M*	3.35	3.48	3.58	3.50	3.46
	SD	.54	.44	.37	.46	.41
16-18	*M*	3.13	3.35	3.45	3.33	3.31
	SD	.58	.62	.53	.56	.51
19-21	*M*	3.04	3.33	3.37	3.18	3.19
	SD	.65	.48	.43	.48	.51
22-24	*M*	3.09	3.44	3.43	3.33	3.27
	SD	.55	.49	.37	.44	.39
More than	*M*	3.25	3.42	3.45	3.41	3.37
24	*SD*	.56	.57	.44	.47	.45
Total	*M*	3.21	3.38	3.46	3.38	3.35
	SD	.58	.58	.48	.51	.48

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J54

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Science Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.73	9	.42	1.84	.059**
Within Groups	137.48	609	.23		
Total	141.21	618			

Note. **Significance at the $p<.05$ level.

Table J55

Teacher Self-Efficacy Means Based on Post-Secondary Science Education Credits Hours (n = 357)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.17	3.34	3.44	3.31	3.30
	SD	.61	.62	.52	.52	.50
1-3	*M*	3.34	3.38	3.48	3.38	3.39
	SD	.48	.63	.46	.47	.42
4-6	*M*	3.13	3.41	3.46	3.36	3.33
	SD	.51	.56	.39	.44	.40
7-9	*M*	3.19	3.65	3.54	3.56	3.42
	SD	.68	.37	.39	.41	.44
10-12	*M*	3.37	3.50	3.52	3.47	3.46
	SD	.55	.48	.46	.51	.48
13-15	*M*	3.37	3.37	3.52	3.46	3.43
	SD	.50	.55	.45	.44	.42
16-18	*M*	3.13	3.46	3.48	3.33	3.31
	SD	.73	.73	.68	.70	.67
19-21	*M*	3.37	3.52	3.53	3.40	3.41
	SD	.77	.74	.49	.57	.56
22-24	*M*	2.93	3.11	3.20	3.20	3.11
	SD	.55	.69	.39	.59	.42
More than	*M*	3.44	3.55	3.58	3.51	3.50
24	*SD*	.48	.50	.40	.44	.41

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J56

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Science Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.35	9	.26	1.17	.311**
Within Groups	77.05	347	.22		
Total	79.39	356			

Note. **Significance at the $p<.05$ level.

Table J57

Teacher Self-Efficacy Means Based on Post-Secondary Technology Credits Hours (n = 604)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.02	3.24	3.30	3.23	3.18
	SD	.72	.70	.63	.62	.61
1-3	*M*	3.31	3.44	3.56	3.43	3.44
	SD	.53	.51	.41	.49	.43
4-6	*M*	3.20	3.38	3.42	3.34	3.31
	SD	.56	.58	.44	.46	.42
7-9	*M*	3.12	3.36	3.45	3.37	3.30
	SD	.42	.60	.41	.43	.37
10-12	*M*	3.32	3.43	3.51	3.47	3.43
	SD	.49	.50	.40	.41	.40
13-15	*M*	3.04	3.30	3.46	3.28	3.27
	SD	.44	.57	.48	.54	.45
16-18	*M*	3.26	3.41	3.51	3.36	3.39
	SD	.68	.69	.58	.63	.61
19-21	*M*	3.22	3.33	3.47	3.29	3.34
	SD	.57	.52	.42	.46	.40
22-24	*M*	3.27	3.49	3.45	3.29	3.33
	SD	.36	.45	.41	.39	.32
More than	*M*	3.30	3.45	3.54	3.45	3.43
24	*SD*	.59	.56	.48	.53	.50

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J58

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Technology Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.72	9	.41	1.86	.055**
Within Groups	131.88	594	.22		
Total	135.61	603			

Note. **Significance at the $p<.05$ level.

Table J59

Teacher Self-Efficacy Means Based on Post-Secondary Technology Education Credits Hours (n = 654)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.11	3.28	3.37	3.31	3.26
	SD	.71	.71	.59	.58	.58
1-3	*M*	3.20	3.43	3.49	3.34	3.33
	SD	.45	.48	.41	.41	.37
4-6	*M*	3.18	3.34	3.40	3.33	3.30
	SD	.51	.58	.44	.49	.43
7-9	*M*	3.14	3.44	3.55	3.37	3.35
	SD	.47	.47	.35	.42	.35
10-12	*M*	3.37	3.42	3.52	3.49	3.47
	SD	.50	.59	.45	.45	.43
13-15	*M*	3.18	3.33	3.49	3.33	3.35
	SD	.51	.51	.46	.45	.41
16-18	*M*	3.08	3.23	3.33	3.16	3.20
	SD	.68	.68	.66	.61	.61
19-21	*M*	3.01	3.32	3.40	3.21	3.21
	SD	.49	.53	.37	.47	.36
22-24	*M*	3.05	3.13	3.36	3.24	3.24
	SD	.47	.53	.51	.62	.51
More than 24	*M*	3.29	3.43	3.53	3.42	3.41
	SD	.56	.57	.47	.50	.48

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J60

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Technology Education Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.72	9	.41	1.89	.051**
Within Groups	141.02	644	.22		
Total	144.75	653			

Note. **Significance at the $p<.05$ level.

Table J61

Teacher Self-Efficacy Means Based on Post-Secondary Engineering Credits Hours (n = 618)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.19	3.32	3.37	3.27	3.26
	SD	.59	.64	.53	.54	.51
1-3	*M*	3.23	3.41	3.50	3.38	3.36
	SD	.49	.52	.43	.45	.40
4-6	*M*	3.24	3.45	3.52	3.48	3.41
	SD	.55	.53	.43	.43	.42
7-9	*M*	3.02	3.29	3.40	3.27	3.23
	SD	.63	.59	.54	.56	.54
10-12	*M*	3.32	3.46	3.52	3.49	3.44
	SD	.58	.58	.52	.52	.50
13-15	*M*	3.26	3.37	3.50	3.35	3.38
	SD	.68	.77	.66	.64	.64
16-18	*M*	3.25	3.45	3.49	3.33	3.37
	SD	.51	.44	.40	.44	.42
19-21	*M*	3.00	3.10	3.33	3.22	3.17
	SD	.48	.63	.40	.56	.43
22-24	*M*	3.07	3.36	3.42	3.39	3.32
	SD	.76	.58	.50	.67	.57
More than 24	*M*	3.23	3.43	3.49	3.42	3.39
	SD	.57	.53	.44	.48	.45

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J62

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Engineering Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.86	9	.32	1.42	.174**
Within Groups	135.44	608	.22		
Total	138.30	617			

Note. **Significance at the p<.05 level.

Table J63

Teacher Self-Efficacy Means Based on Post-Secondary Vocational T&I Education Credits Hours (n = 437)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.19	3.34	3.41	3.35	3.31
	SD	.60	.63	.50	.51	.49
1-3	*M*	3.08	3.40	3.49	3.30	3.29
	SD	.64	.56	.44	.47	.43
4-6	*M*	3.22	3.32	3.39	3.33	3.32
	SD	.59	.67	.57	.60	.54
7-9	*M*	3.03	3.16	3.34	3.19	3.20
	SD	.43	.46	.34	.37	.32
10-12	*M*	3.20	3.46	3.59	3.51	3.46
	SD	.57	.46	.34	.44	.38
13-15	*M*	3.10	3.31	3.41	3.27	3.25
	SD	.67	.73	.70	.77	.71
16-18	*M*	3.28	3.36	3.47	3.28	3.35
	SD	.35	.49	.39	.42	.35
19-21	*M*	2.75	3.08	3.14	2.94	2.97
	SD	.28	.43	.40	.39	.19
22-24	*M*	3.38	3.57	3.60	3.52	3.51
	SD	.49	.56	.45	.44	.41
More than 24	*M*	3.31	3.42	3.54	3.44	3.43
	SD	.60	.54	.47	.49	.48

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J64

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Vocational T&I Education Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.89	9	.43	1.99	.039**
Within Groups	92.86	427	.21		
Total	96.75	436			

Note. **Significance at the p<.05 level.

Table J65

Teacher Self-Efficacy Means Based on Post-Secondary Curriculum and Instruction Credits Hours (n = 684)

Credit Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.21	3.28	3.40	3.27	3.29
	SD	.71	.69	.61	.63	.62
1-3	*M*	3.08	3.21	3.37	3.31	3.27
	SD	.52	.51	.39	.42	.38
4-6	*M*	3.23	3.42	3.47	3.39	3.35
	SD	.53	.60	.48	.48	.45
7-9	*M*	3.11	3.20	3.27	3.25	3.19
	SD	.56	.62	.54	.54	.51
10-12	*M*	3.28	3.42	3.53	3.44	3.43
	SD	.52	.50	.38	.45	.40
13-15	*M*	3.23	3.50	3.51	3.45	3.40
	SD	.56	.51	.45	.50	.47
16-18	*M*	3.18	3.28	3.41	3.27	3.28
	SD	.54	.69	.52	.58	.49
19-21	*M*	3.10	3.44	3.46	3.31	3.28
	SD	.49	.50	.44	.48	.45
22-24	*M*	3.10	3.35	3.46	3.33	3.30
	SD	.67	.67	.61	.63	.61
More than 24	*M*	3.33	3.50	3.57	3.50	3.46
	SD	.55	.50	.39	.44	.42

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J66

ANOVA for Overall Teacher Self-Efficacy Means Based on Post-Secondary Curriculum and Instruction Credits Hours

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	5.33	9	.59	2.81	.003**
Within Groups	141.87	674	.21		
Total	147.20	683			

Note. **Significance at the $p<.05$ level.

Table J67

Frequency Distribution Based on Decision Maker to Teach PLTW (n = 1153)

Decision to Teach PLTW	*N*	%
Self	420	36.43
Department Head	113	9.80
Principal or Assistant Principal	331	28.71
Superintendent or Assistant Superintendent	121	10.49
Area Supervisor	96	8.33
Other	72	6.24
Number of Respondents	1153	
Number of Non-Respondents	4	

Table J68

Teacher Self-Efficacy Means Based on Decision Maker to Teach PLTW (n = 1153)

Decision Maker		AID	MLT	CC	MFL	OAS
Self	*M*	3.21	3.41	3.50	3.38	3.37
	SD	.55	.54	.43	.49	.45
DH	*M*	3.23	3.36	3.45	3.39	3.35
	SD	.62	.58	.51	.54	.53
PA	*M*	3.15	3.32	3.42	3.34	3.31
	SD	.57	.59	.49	.50	.47
SA	*M*	3.20	3.40	3.47	3.39	3.36
	SD	.55	.52	.40	.44	.41
AS	*M*	3.24	3.38	3.45	3.35	3.34
	SD	.50	.53	.44	.45	.41
Other	*M*	3.10	3.26	3.34	3.29	3.25
	SD	.58	.66	.58	.51	.51

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy. DH: Department Head; PA: Principal or Assistant Principal; SA: Superintendent or Assistant Superintendent; and AS: Area Supervisor.

Table J69

ANOVA for Overall Teacher Self-Efficacy Means Based on Decision Maker to Teach PLTW

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.44	5	.29	1.35	.240**
Within Groups	244.14	1147	.21		
Total	245.58	1152			

Note. **Significance at the p<.05 level.

Table J70

Frequency Distribution Based on Non-PLTW Teaching Experience

Years Subjects Taught	*N*	%
Subject		
Mathematics	490	42.57
0	661	57.43
1-5	276	23.98
6-10	109	9.47
11-15	53	4.60
16-20	23	2.00
21-25	14	1.22
26-30	10	0.87
31-35	3	0.26
36-40	0	0
>40	2	0.17
Science	446	38.75
0	705	61.25
1-5	234	20.33
6-10	81	7.04
11-15	60	5.21
16-20	33	2.87
21-25	23	2.00
26-30	7	0.61
31-35	4	0.35
36-40	3	0.26
>40	1	0.09
Technology Education	761	66.11
0	390	33.88
1-5	242	21.03
6-10	153	13.29
11-15	128	11.12
16-20	78	6.78
21-25	72	6.26
26-30	40	3.48
31-35	28	2.43
36-40	17	1.48
>40	3	0.26

(Continued)

Table J70 *Continued*

Years Subjects Taught	*N*	%
Engineering other than PLTW	331	28.76
0	820	71.24
1-5	261	22.68
6-10	38	3.30
11-15	17	1.48
16-20	6	0.52
21-25	5	0.43
26-30	3	0.26
31-35	1	0.09
36-40	0	0
>40	0	0
Vocational T&I Education	418	36.32
0	733	63.68
1-5	242	21.03
6-10	56	4.87
11-15	36	3.13
16-20	27	2.35
21-25	27	2.35
26-30	13	1.13
31-35	9	0.78
36-40	7	0.61
>40	1	0.09
Number of Respondents	1151	
Number of Non-Respondents	6	

Table J71

Teacher Self-Efficacy Means Based on Years Mathematics Classes have been Taught (n = 490)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.14	3.34	3.41	3.34	3.30
	SD	.56	.59	.48	.49	.46
6-10	*M*	3.15	3.38	3.42	3.35	3.30
	SD	.57	.53	.43	.46	.43
11-15	*M*	3.23	3.41	3.49	3.44	3.39
	SD	.51	.56	.46	.47	.44
16-20	*M*	3.19	3.54	3.53	3.44	3.37
	SD	.67	.58	.48	.51	.52
21-25	*M*	3.40	3.48	3.55	3.55	3.49
	SD	.50	.62	.49	.42	.44
26-30	*M*	3.41	3.50	3.62	3.51	3.51
	SD	.35	.42	.34	.37	.34
31-35	*M*	2.62	2.78	3.07	3.11	2.98
	SD	1.21	1.17	.81	.84	.91
>40	*M*	2.57	3.33	3.50	3.44	3.24
	SD	.81	.00	.28	.47	.52

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J72

ANOVA for Overall Teacher Self-Efficacy Means Based on Years Mathematics Classes have been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	9.73	31	.31	1.56	.030**
Within Groups	92.32	458	.20		
Total	102.05	489			

Note. **Significance at the $p<.05$ level.

Table J73

Teacher Self-Efficacy Means Based on Years Science Classes have been Taught (n = 446)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.10	3.30	3.40	3.31	3.27
	SD	0.53	0.59	0.47	0.47	0.44
6-10	*M*	3.23	3.40	3.45	3.39	3.36
	SD	0.61	0.65	0.52	0.57	0.53
11-15	*M*	3.22	3.41	3.47	3.44	3.38
	SD	0.61	0.60	0.52	0.53	0.50
16-20	*M*	3.49	3.56	3.56	3.52	3.50
	SD	0.52	0.56	0.43	0.47	0.43
21-25	*M*	3.30	3.49	3.49	3.45	3.41
	SD	0.54	0.46	0.40	0.46	0.44
26-30	*M*	3.43	3.67	3.49	3.52	3.42
	SD	0.56	0.47	0.42	0.54	0.48
31-35	*M*	3.11	3.25	3.35	3.39	3.31
	SD	0.77	0.57	0.54	0.48	0.55
36-40	*M*	2.48	3.11	3.10	3.00	2.87
	SD	0.44	0.38	0.20	0.11	0.13
>40	*M*	3.00	3.00	3.00	3.56	3.19
	SD	-	-	-	-	-

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J74

ANOVA for Overall Teacher Self-Efficacy Means Based on Years Science Classes have been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	8.63	35	.25	1.13	.284**
Within Groups	89.42	410	.22		
Total	98.05	445			

Note. **Significance at the $p<.05$ level.

Table J75

Teacher Self-Efficacy Means Based on Years Technology Education Classes have been Taught (n = 761)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.12	3.31	3.38	3.31	3.28
	SD	.59	.59	.50	.49	.47
6-10	*M*	3.22	3.40	3.47	3.36	3.35
	SD	.59	.56	.49	.52	.49
11-15	*M*	3.25	3.45	3.53	3.39	3.39
	SD	.58	.60	.48	.54	.49
16-20	*M*	3.21	3.37	3.47	3.37	3.36
	SD	.58	.55	.49	.51	.48
21-25	*M*	3.18	3.41	3.53	3.37	3.35
	SD	.51	.51	.40	.43	.40
26-30	*M*	3.14	3.26	3.43	3.29	3.27
	SD	.57	.62	.54	.55	.53
31-35	*M*	3.32	3.51	3.63	3.44	3.47
	SD	.48	.42	.31	.41	.36
36-40	*M*	3.27	3.24	3.42	3.37	3.36
	SD	.68	.81	.70	.72	.68
>40	*M*	3.48	3.56	3.63	3.52	3.54
	SD	.08	.38	.06	.36	.18

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J76

ANOVA for Overall Teacher Self-Efficacy Means Based on Years Technology Education Classes have been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	15.79	41	.39	1.75	.003**
Within Groups	158.57	719	.22		
Total	174.36	760			

Note. **Significance at the p<.05 level.

Table J77

Teacher Self-Efficacy Means Based on Years Engineering Classes (other than PLTW) have been Taught (n = 331)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.13	3.34	3.40	3.31	3.28
	SD	0.56	0.57	0.46	0.48	0.45
6-10	*M*	3.29	3.46	3.48	3.53	3.43
	SD	0.51	0.52	0.38	0.36	0.36
11-15	*M*	3.30	3.51	3.54	3.49	3.45
	SD	0.66	0.49	0.46	0.46	0.48
16-20	*M*	2.69	3.06	3.33	3.00	3.05
	SD	0.51	0.33	0.36	0.10	0.21
21-25	*M*	3.37	3.27	3.48	3.47	3.39
	SD	0.79	0.64	0.38	0.60	0.62
26-30	*M*	2.81	3.67	3.63	3.22	3.27
	SD	0.46	0.58	0.47	0.62	0.49
31-35	*M*	4.00	4.00	4.00	4.00	4.00
	SD	-	-	-	-	-

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J78

ANOVA for Overall Teacher Self-Efficacy Means Based on Years Engineering Classes (other than PLTW) have been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	4.80	22	.22	1.13	.313**
Within Groups	59.53	308	.19		
Total	64.34	330			

Note. **Significance at the $p<.05$ level.

Table J79

Teacher Self-Efficacy Means Based on Years of Teaching Vocational T&I Education Classes have been Taught (n = 761)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.13	3.32	3.40	3.32	3.29
	SD	0.55	0.59	0.47	0.48	0.45
6-10	*M*	3.23	3.35	3.48	3.30	3.34
	SD	0.58	0.55	0.49	0.54	0.49
11-15	*M*	3.21	3.37	3.41	3.36	3.32
	SD	0.47	0.43	0.40	0.47	0.40
16-20	*M*	3.20	3.43	3.52	3.44	3.40
	SD	0.74	0.69	0.55	0.58	0.55
21-25	*M*	3.49	3.68	3.71	3.65	3.61
	SD	0.59	0.46	0.37	0.42	0.44
26-30	*M*	3.36	3.31	3.55	3.49	3.48
	SD	0.34	0.60	0.48	0.28	0.34
31-35	*M*	3.60	3.59	3.71	3.64	3.66
	SD	0.40	0.40	0.33	0.36	0.33
36-40	*M*	3.12	3.14	3.40	3.24	3.26
	SD	0.50	0.42	0.43	0.40	0.43
>40	*M*	2.57	3.33	3.20	3.67	3.19
	SD	-.	-	-	-	-

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J80

ANOVA for Overall Teacher Self-Efficacy Means Based on Years of Teaching Vocational T&I Education Classes have been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	11.96	40	.30	1.48	.035**
Within Groups	76.32	377	.20		
Total	88.28	417			

Note. **Significance at the $p<.05$ level.

Table J81
Completion of Student Teaching

Student Teaching 1-4 years of experience	*N*	%
Yes	86	62.32%
No	52	37.68%
Number of Respondents	138	
Number of Non-Respondents	3	

Table J82
Teacher Self-Efficacy Means Based on Completion of Student Teaching

Answer		AID	MLT	CC	MFL	OAS
Yes	*M*	3.21	3.36	3.45	3.35	3.34
	SD	.57	.57	.46	.50	.47
No	*M*	3.13	3.30	3.39	3.33	3.29
	SD	.57	.58	.49	.51	.48

Table J83
Student Teaching Under a PLTW Mentor

Student Teaching under a PLTW Mentor	*N*	%
Yes	19	13.77%
No	119	86.23%
Number of Respondents	138	
Number of Non-Respondents	3	

Table J84
Teacher Self-Efficacy Means Based on Student Teaching Under a PLTW Mentor

Answer		AID	MLT	CC	MFL	OAS
Yes	*M*	3.35	3.42	3.51	3.37	3.40
	SD	.55	.54	.50	.53	.50
No	*M*	3.18	3.34	3.43	3.34	3.32
	SD	.57	.58	.47	.50	.47

Table J85
ANOVA for Overall Teacher Self-Efficacy Means Based on Student Teaching Under a PLTW Mentor

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.26	1	.26	1.15	.284**
Within Groups	167.65	741	.23		
Total	167.91	742			

Note. **Significance at the $p<.05$ level.

Table J86

Frequency Distribution Based on Grade Level of PLTW Courses

Grade level of PLTW Courses	*N*	%
5	4	0.12
6	111	3.20
7	197	5.67
8	246	7.09
9	635	18.29
10	752	21.66
11	778	22.41
12	749	21.57
Number of Respondents	1133	
Number of Non-Respondents	23	

Table J87

Teacher Self-Efficacy Means Based on Grade Level of PLTW Courses (n = 1133)

Grade Level		AID	MLT	CC	MFL	OAS
5	*M*	3.00	3.42	3.25	3.31	3.23
	SD	.68	.79	.93	.72	.71
6	*M*	3.33	3.49	3.54	3.44	3.42
	SD	.56	.53	.39	.45	.43
7	*M*	3.29	3.43	3.50	3.38	3.38
	SD	.53	.54	.41	.46	.42
8	*M*	3.30	3.43	3.51	3.40	3.39
	SD	.52	.53	.40	.45	.42
9	*M*	3.16	3.34	3.44	3.34	3.32
	SD	.59	.60	.51	.53	.50
10	*M*	3.16	3.34	3.45	3.35	3.32
	SD	.59	.59	.50	.52	.49
11	*M*	3.17	3.36	3.45	3.35	3.33
	SD	.57	.57	.47	.50	.47
12	*M*	3.17	3.36	3.45	3.35	3.33
	SD	.58	.57	.48	.51	.48

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J88

Frequency Distribution Based on PLTW Teaching Experience

Years Subjects Taught	*N*	%
Subject		
0	22	1.91
1-5	751	65.25
6-10	316	27.45
11-15	59	5.13
16-20	3	0.26
21-25	0	0
26-30	0	0
31-35	0	0
36-40	0	0
>40	0	0
Number of Respondents	1151	
Number of Non-Respondents	6	

Table J89

Teacher Self-Efficacy Means Based on Years PLTW Teaching Experience (n = 1151)

Years		AID	MLT	CC	MFL	OAS
1-5	*M*	3.15	3.31	3.42	3.32	3.30
	SD	.55	.58	.47	.49	.46
6-10	*M*	3.21	3.43	3.49	3.39	3.37
	SD	.60	.56	.49	.51	.49
11-15	*M*	3.45	3.62	3.67	3.58	3.57
	SD	.60	.42	.35	.45	.42
16-20	*M*	3.10	3.00	3.47	3.04	3.23
	SD	.30	.67	.25	.39	.30

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J90

ANOVA for Overall Teacher Self-Efficacy Means Based on Years PLTW Teaching Experience

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	6.30	19	.70	3.43	.002**
Within Groups	243.14	1133	.22		
Total	249.40	1151			

Note. **Significance at the $p<.05$ level.

Table J91

Frequency Distribution Based on Semesters that PLTW Courses had been Taught

Semesters Taught PLTW Courses	*N*
PLTW: Gateway to Technology	
1-3	103
4-6	92
7-9	29
10 or more	61
Total	285
PLTW: Intro to Engineering Design	
1-3	154
4-6	208
7-9	71
10 or more	192
Total	532
PLTW: Principles to Engineering	
1-3	149
4-6	157
7-9	57
10 or more	110
Total	473
PLTW: Digital Electronics	
1-3	105
4-6	79
7-9	31
10 or more	56
Total	271
PLTW: Computer Integrated Manufacturing	
1-3	31
4-6	39
7-9	16
10 or more	40
Total	126

(Continued)

Table J91 *Continued*

Semesters Taught PLTW Courses	*N*
PLTW: Civil Engineering and Architecture	
1-3	52
4-6	62
7-9	20
10 or more	33
Total	167
PLTW: Biotechnical Engineering	
1-3	15
4-6	8
7-9	1
10 or more	2
Total	26
PLTW: Aerospace Engineering	
1-3	24
4-6	21
7-9	4
10 or more	1
Total	50
PLTW: Engineering Design and Development	
1-3	62
4-6	47
7-9	14
10 or more	37
Total	160
Number of Respondents	1143
Number of Non-Respondents	14

Table J92

Teacher Self-Efficacy Means Based on Semesters that PLTW Courses had been Taught (n = 1143)

Semesters		AID	MLT	CC	MFL	OAS
Gateway to Technology						
1-3	*M*	3.28	3.33	3.47	3.35	3.35
	SD	.51	.59	.42	.46	.42
4-6	*M*	3.13	3.34	3.37	3.28	3.25
	SD	.49	.55	.43	.45	.41
7-9	*M*	3.36	3.51	3.60	3.47	3.46
	SD	.51	.43	.34	.38	.36
10 or more	*M*	3.39	3.52	3.58	3.48	3.48
	SD	.57	.44	.37	.44	.42
Intro to Engineering Design						
1-3	*M*	3.08	3.25	3.37	3.27	3.24
	SD	.56	.61	.50	.52	.48
4-6	*M*	3.14	3.30	3.41	3.31	3.29
	SD	.58	.58	.51	.53	.50
7-9	*M*	3.19	3.38	3.51	3.38	3.35
	SD	.56	.57	.48	.53	.49
10 or more	*M*	3.25	3.43	3.51	3.40	3.39
	SD	.61	.58	.47	.51	.49
Principles to Engineering						
1-3	*M*	3.10	3.32	3.42	3.32	3.29
	SD	.57	.56	.47	.49	.45
4-6	*M*	3.15	3.28	3.41	3.31	3.31
	SD	.56	.59	.48	.52	.48
7-9	*M*	3.19	3.42	3.49	3.43	3.36
	SD	.52	.49	.41	.44	.41
10 or more	*M*	3.23	3.39	3.50	3.39	3.37
	SD	.60	.61	.50	.52	.50
Digital Electronics						
1-3	*M*	3.08	3.31	3.45	3.32	3.28
	SD	.61	.54	.47	.52	.48
4-6	*M*	3.16	3.32	3.42	3.31	3.30
	SD	.52	.57	.45	.44	.44
7-9	*M*	3.13	3.26	3.38	3.31	3.28
	SD	.48	.60	.41	.47	.39
10 or more	*M*	3.33	3.57	3.61	3.49	3.48
	SD	.57	.47	.40	.44	.42

(Continued)

Table J92 *Continued*

Semesters		AID	MLT	CC	MFL	OAS
Computer Integrated Manufacturing						
1-3	*M*	3.11	3.30	3.39	3.25	3.26
	SD	.67	.73	.69	.70	.67
4-6	*M*	3.16	3.42	3.41	3.35	3.30
	SD	.60	.53	.52	.48	.49
7-9	*M*	3.26	3.29	3.48	3.36	3.37
	SD	.51	.57	.47	.40	.41
10 or more	*M*	3.40	3.50	3.64	3.47	3.51
	SD	.52	.47	.33	.40	.37
Civil Engineering and Architecture						
1-3	*M*	3.12	3.38	3.49	3.41	3.35
	SD	.49	.52	.42	.44	.40
4-6	*M*	3.15	3.38	3.46	3.34	3.33
	SD	.65	.55	.45	.50	.47
7-9	*M*	3.23	3.37	3.51	3.37	3.37
	SD	.61	.74	.65	.71	.63
10 or more	*M*	3.32	3.47	3.57	3.46	3.46
	SD	.67	.62	.57	.59	.57
Biotechnical Engineering						
1-3	*M*	3.29	3.42	3.46	3.39	3.38
	SD	.63	.64	.43	.57	.49
4-6	*M*	3.27	3.50	3.50	3.43	3.39
	SD	.67	.56	.48	.60	.59
7-9	*M*	4.00	3.67	3.90	4.00	3.97
	SD	-	-	-	-	-
10 or more	*M*	2.64	3.50	3.60	3.61	3.31
	SD	1.52	.24	.28	.24	.52
Aerospace Engineering						
1-3	*M*	3.10	3.26	3.40	3.34	3.29
	SD	.56	.61	.48	.42	.42
4-6	*M*	3.23	3.46	3.44	3.35	3.34
	SD	.53	.52	.46	.45	.45
7-9	*M*	3.29	3.25	3.68	3.47	3.49
	SD	.56	.50	.22	.45	.35
10 or more	*M*	3.29	3.00	3.10	3.33	3.26
	SD	-	-	-	-	-

(Continued)

Table J92 *Continued*

Semesters		AID	MLT	CC	MFL	OAS
Engineering Design and Development						
1-3	*M*	3.17	3.40	3.50	3.41	3.36
	SD	.59	.52	.45	.48	.45
4-6	*M*	3.21	3.48	3.54	3.39	3.38
	SD	.49	.50	.43	.43	.40
7-9	*M*	3.26	3.62	3.65	3.48	3.48
	SD	.62	.43	.32	.43	.39
10 or more	*M*	3.42	3.46	3.58	3.49	3.52
	SD	.63	.56	.46	.51	.47

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J93

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Gateway to Technology had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.42	3	1.14	5.43	.001**
Within Groups	112.15	534	.21		
Total	115.57	537			

Note. **Significance at the $p<.05$ level.

Table J94

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Intro to Engineering Design had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.91	3	.64	2.84	.037**
Within Groups	173.79	776	.22		
Total	175.70	779			

Note. **Significance at the $p<.05$ level.

Table J95

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Principles to Engineering had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.23	3	.410	1.869	.134**
Within Groups	142.57	649	.220		
Total	143.804	652			

Note. **Significance at the *p*<.05 level.

Table J96

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Digital Electronics had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.83	3	.61	2.89	.035**
Within Groups	107.07	507	.21		
Total	108.91	510			

Note. **Significance at the *p*<.05 level.

Table J97

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Computer Integrated Manufacturing had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.17	3	.72	3.03	.029**
Within Groups	94.89	398	.24		
Total	97.06	401			

Note. **Significance at the *p*<.05 level.

Table J98

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Civil Engineering and Architecture had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.58	3	.53	2.19	.089**
Within Groups	106.24	441	.24		
Total	107.82	444			

Note. **Significance at the *p*<.05 level.

Table J99

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Biotechnical Engineering had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.65	3	.22	.94	.424**
Within Groups	76.04	328	.23		
Total	76.69	331			

Note. **Significance at the $p<.05$ level.

Table J100

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Aerospace Engineering had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.15	3	.05	.27	.849**
Within Groups	8.53	46	.19		
Total	8.67	49			

Note. **Significance at the $p<.05$ level.

Table 101

ANOVA for Overall Teacher Self-Efficacy Means Based on Semesters that Engineering Design and Development had been Taught

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.68	3	.23	1.21	.310**
Within Groups	29.46	156	.19		
Total	30.14	159			

Note. **Significance at the $p<.05$ level.

Table J102

Frequency Distribution Based on Sections of Classes Taught during 2010 Fall Semester

Sections Taught	*N*
Middle School PLTW: Gateway to Technology	
0	882
1	33
2	57
3	36
4	33
5	28
> 5	73
Middle School Mathematics Classes	
0	1117
1	5
2	13
3	5
4	2
5	0
> 5	0
Middle School Science Classes	
0	1114
1	3
2	4
3	8
4	8
5	4
> 5	1
Middle School Technology Education Classes	
0	1080
1	13
2	8
3	8
4	14
5	7
> 5	12

(Continued)

Table J102 *Continued*

Sections Taught	*N*
Middle School Engineering (other than PLTW) Classes	
0	1133
1	3
2	3
3	0
4	0
5	0
> 5	1
Other Middle School Classes	
0	1111
1	16
2	7
3	1
4	2
5	2
> 5	3
High School PLTW: Intro to Engineering Design	
0	607
1	183
2	192
3	97
4	42
5	15
> 5	6
High School PLTW: Principles of Engineering	
0	779
1	225
2	99
3	28
4	9
5	0
> 5	2

(Continued)

Table J102 *Continued*

Sections Taught	*N*
High School PLTW: Digital Electronics	
0	954
1	140
2	41
3	4
4	0
5	3
> 5	0
High School PLTW: Computer Integrated Manufacturing	
0	1053
1	70
2	15
3	1
4	2
5	0
> 5	1
High School PLTW: Civil Engineering and Architecture	
0	1020
1	95
2	22
3	4
4	0
5	0
> 5	1
High School PLTW: Biotechnical Engineering	
0	1123
1	12
2	3
3	2
4	1
5	1
> 5	0

(Continued)

Table J102 *Continued*

Sections Taught	*N*
High School PLTW: Aerospace Engineering	
0	1103
1	29
2	7
3	0
4	0
5	0
> 5	1
High School PLTW: Engineering Design and Development	
0	1034
1	91
2	12
3	2
4	1
5	0
> 5	2
High School Mathematics Classes	
0	1038
1	21
2	31
3	18
4	21
5	9
> 5	4
High School Science Classes	
0	1051
1	15
2	20
3	23
4	15
5	14
> 5	4

(Continued)

Table J102 *Continued*

Sections Taught	*N*
High School Technology Education Classes	
0	946
1	48
2	59
3	36
4	22
5	12
> 5	19
High School Engineering (other than PLTW) Classes	
0	1095
1	22
2	15
3	3
4	4
5	1
> 5	2
Other High School Classes	
0	1062
1	24
2	32
3	8
4	7
5	3
> 5	6
Number of Respondents	1140
Number of Non-Respondents	17

Table J103

Teacher Self-Efficacy Means Based on Sections of Classes Taught during 2010 Fall Semester (n = 1140)

Sections		AID	MLT	CC	MFL	OAS
Gateway to Technology						
1	*M*	3.33	3.37	3.47	3.36	3.36
	SD	.53	.61	.41	.48	.44
2	*M*	3.25	3.36	3.45	3.34	3.34
	SD	.49	.59	.42	.46	.41
3	*M*	3.11	3.27	3.35	3.25	3.22
	SD	.61	.57	.46	.47	.48
4	*M*	3.20	3.39	3.46	3.38	3.33
	SD	.49	.44	.40	.37	.37
5	*M*	3.27	3.37	3.47	3.30	3.34
	SD	.51	.42	.36	.39	.38
>5	*M*	3.42	3.55	3.59	3.53	3.51
	SD	.53	.51	.38	.44	.41
Middle School Mathematics Classes						
1	*M*	2.91	3.40	3.54	3.47	3.28
	SD	.79	.43	.42	.43	.48
2	*M*	3.25	3.46	3.42	3.39	3.34
	SD	.59	.48	.39	.46	.44
3	*M*	3.03	3.20	3.34	3.31	3.25
	SD	.67	.65	.50	.51	.53
4	*M*	3.29	4.00	3.90	3.89	3.71
	SD	1.01	.00	.14	.16	.41
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
Middle School Science Classes						
1	*M*	3.48	3.11	3.27	3.04	3.19
	SD	.50	.19	.38	.65	.56
2	*M*	3.32	3.42	3.55	3.47	3.44
	SD	.74	.57	.34	.51	.45
3	*M*	3.04	3.21	3.36	3.35	3.26
	SD	.82	.69	.52	.57	.61
4	*M*	3.21	3.21	3.33	3.33	3.31
	SD	.42	.56	.46	.41	.35
5	*M*	3.18	3.08	3.25	3.14	3.19
	SD	.32	.17	.19	.17	.22
>5	*M*	3.14	4.00	3.80	3.44	3.45
	SD	-	-	-	-	-

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
Middle School Technology Education Classes						
1	*M*	3.04	3.33	3.27	3.20	3.16
	SD	.56	.47	.45	.51	.47
2	*M*	3.23	3.42	3.56	3.29	3.33
	SD	.47	.39	.26	.35	.31
3	*M*	3.43	3.50	3.46	3.50	3.41
	SD	.50	.50	.44	.42	.44
4	*M*	3.19	3.26	3.41	3.21	3.25
	SD	.52	.53	.40	.43	.41
5	*M*	3.27	3.48	3.61	3.41	3.44
	SD	.70	.60	.43	.39	.32
>5	*M*	3.33	3.56	3.63	3.46	3.46
	SD	.47	.38	.31	.43	.39
Middle School Engineering Education Classes						
1	*M*	3.33	3.56	3.77	3.70	3.63
	SD	1.15	.77	.40	.51	.63
2	*M*	3.05	3.00	2.97	3.07	2.90
	SD	.30	.67	.49	.23	.03
3	*M*	2.57	2.83	3.35	3.00	3.00
	SD	.20	.24	.21	.00	.18
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	4.00	4.00	4.00	3.89	3.97
	SD	-	-	-	-	-
Middle School Other Middle School Classes						
1	*M*	3.17	3.13	3.27	3.17	3.20
	SD	.58	.63	.50	.41	.41
2	*M*	3.59	3.67	3.76	3.67	3.66
	SD	.51	.38	.36	.43	.42
3	*M*	3.43	3.67	3.40	3.56	3.32
	SD	-	-	-	-	-
4	*M*	3.36	3.83	3.65	3.33	3.40
	SD	.30	.24	.35	.16	.25
5	*M*	3.29	2.83	3.25	3.11	3.24
	SD	.40	.24	.21	.16	.30
>5	*M*	3.29	3.22	3.43	3.22	3.29
	SD	.43	.38	.38	.38	.24

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Intro to Engineering Design						
1	*M*	3.11	3.25	3.38	3.30	3.26
	SD	.56	.60	.52	.54	.49
2	*M*	3.17	3.33	3.45	3.31	3.32
	SD	.55	.56	.44	.48	.45
3	*M*	3.05	3.29	3.40	3.30	3.26
	SD	.62	.60	.51	.51	.50
4	*M*	3.30	3.44	3.48	3.40	3.40
	SD	.68	.70	.66	.72	.67
5	*M*	3.45	3.58	3.71	3.64	3.59
	SD	.50	.58	.37	.30	.34
>5	*M*	3.74	3.67	3.67	3.74	3.68
	SD	.39	.42	.36	.38	.36
High School PLTW: Principles of Engineering						
1	*M*	3.11	3.28	3.40	3.29	3.27
	SD	.58	.59	.48	.51	.47
2	*M*	3.18	3.33	3.45	3.31	3.32
	SD	.61	.64	.53	.54	.52
3	*M*	3.14	3.33	3.48	3.37	3.34
	SD	.60	.48	.45	.47	.47
4	*M*	3.22	3.89	3.81	3.80	3.65
	SD	.62	.24	.24	.17	.29
5	*M*	3.36	3.33	3.65	3.61	3.56
	SD	.91	.00	.07	.24	.39
>5	*M*	3.11	3.28	3.40	3.29	3.27
	SD	.58	.59	.48	.51	.47
High School PLTW: Digital Electronics						
1	*M*	3.14	3.32	3.45	3.34	3.32
	SD	.53	.55	.42	.46	.42
2	*M*	3.30	3.55	3.53	3.51	3.44
	SD	.70	.59	.57	.58	.58
3	*M*	3.11	3.50	3.68	3.67	3.50
	SD	.76	.43	.28	.33	.43
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	3.86	3.78	3.80	3.74	3.80
	SD	.25	.19	.10	.36	.22
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Computer Integrated Manufacturing						
1	*M*	3.22	3.35	3.45	3.32	3.32
	SD	0.59	0.62	0.56	0.56	0.54
2	*M*	3.13	3.44	3.56	3.34	3.40
	SD	0.52	0.39	0.33	0.38	0.33
3	*M*	3.00	3.00	3.50	3.22	3.42
	SD	-	-	-	-	-
4	*M*	2.93	3.50	3.65	3.61	3.44
	SD	0.51	0.24	0.07	0.08	0.07
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	2.57	3.00	3.10	3.00	2.90
	SD	.	.	.	.	.
High School PLTW: Civil Engineering and Architecture						
1	*M*	3.19	3.39	3.51	3.36	3.36
	SD	.61	.58	.49	.52	.49
2	*M*	3.28	3.56	3.54	3.48	3.43
	SD	.57	.46	.46	.45	.46
3	*M*	3.29	3.67	3.78	3.39	3.51
	SD	.68	.38	.17	.42	.38
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	3.19	3.39	3.51	3.36	3.36
	SD	.61	.58	.49	.52	.49
High School PLTW: Biotechnical Engineering						
1	*M*	3.27	3.56	3.47	3.51	3.42
	SD	.74	.52	.41	.50	.48
2	*M*	3.10	2.89	3.37	3.11	3.23
	SD	1.01	.77	.31	.80	.67
3	*M*	3.36	3.67	3.50	3.72	3.50
	SD	.30	.47	.28	.24	.25
4	*M*	4.00	4.00	4.00	4.00	4.00
	SD	-	-	-	-	-
5	*M*	2.43	3.00	2.90	2.56	2.55
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Aerospace Engineering						
1	*M*	3.08	3.16	3.28	3.27	3.22
	SD	.54	.56	.43	.41	.40
2	*M*	3.31	3.62	3.77	3.48	3.54
	SD	.38	.30	.24	.35	.27
3	*M*	2.79	3.33	3.20	3.39	3.11
	SD	.91	.94	.71	.55	.62
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	3.43	4.00	3.90	3.44	3.65
	SD	-	-	-	-	-
High School PLTW: Engineering Design/Development						
1	*M*	3.28	3.49	3.58	3.44	3.44
	SD	.57	.53	.42	.49	.43
2	*M*	3.21	3.44	3.56	3.50	3.45
	SD	.70	.74	.62	.54	.56
3	*M*	3.43	3.33	3.35	3.33	3.35
	SD	.81	.00	.49	.63	.68
4	*M*	3.57	4.00	4.00	4.00	3.90
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	3.86	3.83	3.85	3.67	3.73
	SD	.00	.24	.21	.16	.16

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School Mathematics Classes						
1	*M*	3.07	3.33	3.41	3.32	3.27
	SD	.60	.54	.44	.47	.42
2	*M*	3.06	3.39	3.46	3.39	3.32
	SD	.60	.63	.53	.43	.47
3	*M*	2.96	3.07	3.22	3.20	3.13
	SD	.61	.71	.57	.52	.54
4	*M*	3.20	3.38	3.44	3.42	3.35
	SD	.56	.58	.45	.51	.46
5	*M*	3.14	3.11	3.32	3.16	3.20
	SD	.52	.58	.51	.49	.49
>5	*M*	2.61	3.25	3.25	3.08	2.99
	SD	.47	.88	.70	.64	.49
High School Science Classes						
1	*M*	3.20	3.51	3.51	3.41	3.36
	SD	.59	.60	.55	.55	.53
2	*M*	3.29	3.27	3.42	3.34	3.35
	SD	.57	.69	.52	.53	.50
3	*M*	3.11	3.19	3.40	3.30	3.27
	SD	.62	.57	.42	.50	.42
4	*M*	3.00	3.20	3.27	3.33	3.22
	SD	.55	.53	.40	.39	.39
5	*M*	3.18	3.43	3.45	3.49	3.40
	SD	.43	.59	.38	.39	.36
>5	*M*	3.18	3.50	3.23	3.17	3.16
	SD	.65	.58	.51	.52	.51
High School Technology Education Classes						
1	*M*	3.13	3.20	3.35	3.27	3.26
	SD	.59	.60	.51	.48	.46
2	*M*	3.21	3.39	3.52	3.37	3.36
	SD	.60	.50	.39	.44	.45
3	*M*	3.21	3.44	3.59	3.43	3.41
	SD	.41	.49	.31	.38	.31
4	*M*	2.99	3.30	3.38	3.19	3.18
	SD	.55	.51	.42	.47	.42
5	*M*	3.20	3.39	3.42	3.27	3.28
	SD	.62	.63	.61	.64	.59
>5	*M*	3.35	3.39	3.55	3.36	3.46
	SD	.52	.52	.33	.46	.37

(Continued)

Table J103 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School Engineering Other than PLTW						
1	*M*	3.16	3.18	3.41	3.31	3.30
	SD	.51	.53	.44	.45	.42
2	*M*	2.99	3.18	3.39	3.40	3.30
	SD	.65	.64	.52	.45	.47
3	*M*	2.67	2.78	3.10	2.96	2.99
	SD	.54	1.02	.75	.42	.57
4	*M*	3.21	3.00	3.15	3.17	3.20
	SD	.38	.47	.65	.52	.51
5	*M*	2.86	3.00	3.00	3.00	2.94
	SD	-	-	-	-	-
>5	*M*	3.71	3.67	3.80	3.61	3.74
	SD	.40	.47	.14	.24	.14
High School Other Classes						
1	*M*	3.05	3.18	3.28	3.14	3.16
	SD	.58	.52	.50	.58	.49
2	*M*	3.13	3.32	3.45	3.32	3.31
	SD	.61	.57	.45	.54	.47
3	*M*	3.23	3.25	3.41	3.43	3.39
	SD	.42	.50	.39	.40	.39
4	*M*	2.94	3.00	3.11	3.19	3.08
	SD	.55	.61	.59	.40	.47
5	*M*	3.43	3.33	3.63	3.52	3.52
	SD	.29	.88	.55	.46	.36
>5	*M*	3.50	3.56	3.70	3.52	3.58
	SD	.55	.50	.38	.46	.44

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J104

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Gateway to Technology Classes Taught during 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.65	6	.61	2.91	.010**
Within Groups	113.55	542	.21		
Total	117.21	548			

Note. **Significance at the $p<.05$ level.

Table J105

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Middle School Mathematics Classes Taught during 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.43	4	.11	.48	.748**
Within Groups	77.56	346	.22		
Total	78.00	350			

Note. **Significance at the *p*<.05 level.

Table J106

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Middle School Science Classes Taught during 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.19	6	.03	.14	.990**
Within Groups	77.26	344	.23		
Total	77.45	350			

Note. **Significance at the *p*<.05 level.

Table J107

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Middle School Technology Education Classes Taught during 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.95	6	.16	.72	.634**
Within Groups	81.44	369	.22		
Total	82.39	375			

Note. **Significance at the *p*<.05 level.

Table J108

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Middle School Engineering Education Classes (other than PLTW) Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.43	4	.36	1.60	.174**
Within Groups	74.67	333	.22		
Total	76.10	337			

Note. **Significance at the *p*<.05 level.

Table J109

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Intro to Engineering Design Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.10	6	.52	2.34	.030**
Within Groups	161.10	729	.22		
Total	164.21	735			

Note. **Significance at the p<.05 level.

Table J110

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Principle of Engineering Design Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.50	5	.30	1.38	.232**
Within Groups	128.14	588	.22		
Total	129.64	593			

Note. **Significance at the p<.05 level.

Table J111

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Digital Electronics Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.29	4	.57	2.74	.028**
Within Groups	98.44	471	.21		
Total	100.72	475			

Note. **Significance at the p<.05 level.

Table J112

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Computer Integrated Manufacturing Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.54	5	.11	.47	.796**
Within Groups	90.26	394	.23		
Total	90.80	399			

Note. **Significance at the p<.05 level.

Table J113

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Civil Engineering and Architecture Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.60	4	.40	1.71	.146**
Within Groups	98.67	422	.23		
Total	100.28	426			

Note. **Significance at the p<.05 level.

Table J114

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Biotechnical Engineering Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.41	5	.28	1.25	.286**
Within Groups	76.40	339	.23		
Total	77.80	344			

Note. **Significance at the p<.05 level.

Table J115

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Aerospace Engineering Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.77	4	.19	.87	.484**
Within Groups	79.57	357	.22		
Total	80.34	361			

Note. **Significance at the p<.05 level.

Table J116

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Engineering Design and Development Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	3.51	5	.70	3.22	.007**
Within Groups	87.37	401	.22		
Total	90.88	406			

Note. **Significance at the p<.05 level.

Table J117

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections High School Mathematics Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.97	6	.16	.72	.633**
Within Groups	84.40	376	.22		
Total	85.37	382			

Note. **Significance at the p<.05 level.

Table J118

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections High School Science Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.54	6	.09	.41	.874**
Within Groups	80.84	363	.22		
Total	81.38	369			

Note. **Significance at the p<.05 level.

Table J119

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections High School Technology Education Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.15	6	.36	1.67	.128**
Within Groups	93.20	434	.22		
Total	95.34	440			

Note. **Significance at the p<.05 level.

Table J120

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of High School Engineering (other than PLTW) Classes Taught During 2010 Fall Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	.85	6	.14	.63	.847**
Within Groups	77.97	345	.23		
Total	78.82	351			

Note. **Significance at the p<.05 level.

Table J121

Frequency Distribution Based on Sections of Classes Taught during 2011 Spring Semester

Sections Taught	*N*
Middle School PLTW: Gateway to Technology	
0	879
1	36
2	54
3	38
4	36
5	36
> 5	61
Middle School Mathematics Classes	
0	1114
1	4
2	14
3	5
4	2
5	1
> 5	1114
Middle School Science Classes	
0	1113
1	3
2	3
3	7
4	9
5	4
> 5	1
Middle School Technology Education Classes	
0	1088
1	8
2	10
3	7
4	14
5	7
> 5	6

(Continued)

Table J121 *Continued*

Sections Taught	*N*
Middle School Engineering (other than PLTW) Classes	
0	1130
1	4
2	4
3	1
4	1
5	339
> 5	801
Other Middle School Classes	
0	1108
1	17
2	5
3	4
4	2
5	3
> 5	1
High School PLTW: Intro to Engineering Design	
0	641
1	194
2	160
3	88
4	42
5	13
> 5	2
High School PLTW: Principles of Engineering	
0	757
1	240
2	107
3	25
4	9
5	1
> 5	1

(Continued)

Table J121 *Continued*

Sections Taught	*N*
High School PLTW: Digital Electronics	
0	944
1	152
2	37
3	3
4	1
5	3
> 5	0
High School PLTW: Computer Integrated Manufacturing	
0	1059
1	58
2	19
3	2
4	2
5	0
> 5	0
High School PLTW: Civil Engineering and Architecture	
0	1024
1	94
2	17
3	5
4	0
5	0
> 5	0
High School PLTW: Biotechnical Engineering	
0	1122
1	11
2	3
3	2
4	1
5	1
> 5	0

(Continued)

Table J121 *Continued*

Sections Taught	*N*
High School PLTW: Aerospace Engineering	
0	1106
1	26
2	5
3	2
4	1
5	0
> 5	0
High School PLTW: Engineering Design and Development	
0	1012
1	110
2	14
3	2
4	1
5	0
> 5	1
High School Mathematics Classes	
0	1040
1	21
2	31
3	16
4	19
5	9
> 5	4
High School Science Classes	
0	1049
1	17
2	20
3	24
4	14
5	15
> 5	1

(Continued)

Table J121 *Continued*

Sections Taught	*N*
High School Technology Education Classes	
0	949
1	56
2	55
3	38
4	19
5	11
> 5	12
High School Engineering (other than PLTW) Classes	
0	1096
1	21
2	12
3	4
4	5
5	0
> 5	2
Other High School Classes	
0	1062
1	28
2	25
3	10
4	5
5	4
> 5	6
Number of Respondents	1140
Number of Non-Respondents	17

Table J122

Teacher Self-Efficacy Means Based on Sections of Classes Taught during 2011 Spring Semester (n = 1140)

Sections		AID	MLT	CC	MFL	OAS
Gateway to Technology						
1	*M*	3.34	3.39	3.51	3.41	3.40
	SD	.49	.60	.41	.47	.43
2	*M*	3.25	3.28	3.38	3.30	3.31
	SD	.46	.58	.44	.45	.40
3	*M*	3.11	3.36	3.41	3.25	3.23
	SD	.64	.57	.43	.49	.49
4	*M*	3.19	3.38	3.42	3.31	3.29
	SD	.49	.44	.40	.40	.37
5	*M*	3.23	3.36	3.47	3.33	3.35
	SD	.54	.51	.36	.43	.40
>5	*M*	3.46	3.58	3.62	3.56	3.54
	SD	.50	.47	.37	.41	.38
Middle School Mathematics Classes						
1	*M*	3.07	3.50	3.68	3.50	3.38
	SD	.81	.43	.34	.49	.49
2	*M*	3.31	3.50	3.44	3.44	3.38
	SD	.60	.48	.40	.47	.45
3	*M*	3.03	3.20	3.34	3.31	3.25
	SD	.67	.65	.50	.51	.53
4	*M*	3.29	4.00	3.90	3.89	3.71
	SD	1.01	.00	.14	.16	.41
5	*M*	3.86	4.00	3.80	3.78	3.81
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
Middle School Science Classes						
1	*M*	3.67	3.67	3.67	3.44	3.54
	SD	.58	.58	.58	.78	.64
2	*M*	3.10	3.22	3.40	3.37	3.31
	SD	.72	.51	.20	.57	.46
3	*M*	2.82	3.10	3.29	3.24	3.13
	SD	.67	.66	.50	.52	.54
4	*M*	3.19	3.22	3.34	3.33	3.30
	SD	.40	.53	.44	.38	.33
5	*M*	3.18	3.08	3.25	3.14	3.19
	SD	.32	.17	.19	.17	.22
>5	*M*	3.14	4.00	3.80	3.44	3.45
	SD	-	-	-	-	-

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
Middle School Technology Education Classes						
1	*M*	2.98	3.17	3.19	3.14	3.09
	SD	.46	.36	.36	.34	.33
2	*M*	3.44	3.50	3.60	3.41	3.45
	SD	.47	.39	.31	.45	.41
3	*M*	2.71	3.33	3.23	3.11	2.97
	SD	.30	.58	.57	.46	.39
4	*M*	3.28	3.26	3.39	3.26	3.31
	SD	.54	.59	.45	.47	.43
5	*M*	3.04	3.38	3.56	3.29	3.29
	SD	.65	.49	.40	.47	.39
>5	*M*	3.57	3.61	3.73	3.61	3.61
	SD	.31	.39	.15	.24	.22
Middle School Engineering Education Classes						
1	*M*	2.61	2.83	2.93	2.75	2.72
	SD	1.28	1.35	1.26	1.26	1.22
2	*M*	2.71	2.75	2.97	3.00	2.90
	SD	.71	.32	.40	.24	.12
3	*M*	2.71	2.67	3.50	3.00	3.13
	SD	-	-	-	-	-
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	4.00	4.00	4.00	3.89	3.97
	SD	-	-	-	-	-
Middle School Other Middle School Classes						
1	*M*	3.35	3.29	3.38	3.30	3.32
	SD	.45	.51	.44	.37	.34
2	*M*	3.60	3.53	3.60	3.60	3.59
	SD	.55	.51	.50	.55	.53
3	*M*	3.14	3.08	3.13	3.25	3.07
	SD	.51	.42	.22	.25	.20
4	*M*	3.36	3.83	3.65	3.33	3.40
	SD	.30	.24	.35	.16	.25
5	*M*	3.43	3.00	3.37	3.19	3.35
	SD	.38	.33	.25	.17	.29
>5	*M*	3.71	3.00	3.60	3.44	3.52
	SD	-	-	-	-	-

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Intro to Engineering Design						
1	*M*	3.07	3.27	3.40	3.25	3.24
	SD	.53	.56	.48	.51	.45
2	*M*	3.16	3.28	3.43	3.30	3.30
	SD	.58	.59	.46	.48	.46
3	*M*	3.09	3.36	3.43	3.34	3.30
	SD	.65	.60	.52	.52	.51
4	*M*	3.28	3.42	3.47	3.38	3.38
	SD	.67	.69	.66	.72	.66
5	*M*	3.42	3.54	3.72	3.62	3.58
	SD	.52	.62	.37	.30	.34
>5	*M*	3.86	3.83	3.75	3.94	3.84
	SD	.20	.24	.21	.08	.18
High School PLTW: Principles of Engineering						
1	*M*	3.14	3.27	3.42	3.31	3.30
	SD	.59	.58	.47	.51	.48
2	*M*	3.20	3.35	3.48	3.34	3.35
	SD	.56	.59	.48	.50	.47
3	*M*	3.12	3.33	3.46	3.38	3.33
	SD	.55	.43	.44	.43	.44
4	*M*	2.94	3.63	3.52	3.62	3.40
	SD	.48	.51	.54	.30	.36
5	*M*	3.29	3.67	3.30	3.56	3.32
	SD	-	-	-	-	-
>5	*M*	2.71	3.33	3.60	3.44	3.29
	SD	-	-	-	-	-
High School PLTW: Digital Electronics						
1	*M*	3.16	3.31	3.44	3.31	3.31
	SD	.53	.56	.42	.49	.43
2	*M*	3.24	3.53	3.50	3.50	3.40
	SD	.69	.59	.58	.56	.57
3	*M*	3.29	3.78	3.67	3.70	3.56
	SD	.65	.19	.42	.42	.51
4	*M*	3.43	4.00	3.90	3.44	3.65
	SD	-	-	-	-	-
5	*M*	3.86	3.78	3.80	3.74	3.80
	SD	.25	.19	.10	.36	.22
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Computer Integrated Manufacturing						
1	*M*	3.28	3.35	3.46	3.34	3.35
	SD	.63	.66	.61	.59	.58
2	*M*	3.10	3.37	3.49	3.34	3.34
	SD	.55	.54	.43	.43	.41
3	*M*	2.79	3.00	3.30	3.11	3.16
	SD	.30	.00	.28	.16	.36
4	*M*	3.00	3.67	3.75	3.50	3.52
	SD	.61	.47	.21	.08	.18
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
High School PLTW: Civil Engineering and Architecture						
1	*M*	3.18	3.38	3.50	3.36	3.36
	SD	.62	.58	.49	.54	.50
2	*M*	3.23	3.55	3.55	3.46	3.40
	SD	.57	.46	.42	.41	.44
3	*M*	3.43	3.73	3.82	3.51	3.61
	SD	.67	.37	.18	.46	.40
4	*M*	-	-	-	-	-
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
High School PLTW: Biotechnical Engineering						
1	*M*	3.18	3.55	3.45	3.47	3.38
	SD	.78	.54	.45	.48	.48
2	*M*	2.76	2.78	3.13	2.85	2.95
	SD	.68	.69	.15	.57	.41
3	*M*	3.36	3.67	3.50	3.72	3.50
	SD	.30	.47	.28	.24	.25
4	*M*	4.00	4.00	4.00	4.00	4.00
	SD	-	-	-	-	-
5	*M*	2.43	3.00	2.90	2.56	2.55
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School PLTW: Aerospace Engineering						
1	*M*	3.10	3.22	3.33	3.28	3.26
	SD	.52	.58	.45	.43	.41
2	*M*	3.46	3.60	3.78	3.60	3.63
	SD	.34	.37	.29	.34	.26
3	*M*	2.79	3.33	3.20	3.39	3.11
	SD	.91	.94	.71	.55	.62
4	*M*	3.43	4.00	3.90	3.44	3.65
	SD	-	-	-	-	-
5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
>5	*M*	-	-	-	-	-
	SD	-	-	-	-	-
High School PLTW: Engineering Design and Development						
1	*M*	3.25	3.43	3.54	3.42	3.41
	SD	.57	.51	.42	.46	.43
2	*M*	3.18	3.55	3.63	3.57	3.48
	SD	.75	.70	.57	.52	.55
3	*M*	3.36	3.67	3.50	3.33	3.39
	SD	.71	.47	.71	.63	.73
4	*M*	3.57	4.00	4.00	4.00	3.90
	SD	-	-	-	-	-
5	*M*	3.86	4.00	4.00	3.78	3.84
	SD	-	-	-	-	-
>5	*M*	3.25	3.43	3.54	3.42	3.41
	SD	.57	.51	.42	.46	.43
High School Mathematics Classes						
1	*M*	2.99	3.35	3.39	3.24	3.22
	SD	.54	.45	.41	.44	.38
2	*M*	3.06	3.31	3.42	3.37	3.30
	SD	.60	.66	.54	.44	.48
3	*M*	2.95	3.08	3.21	3.25	3.14
	SD	.66	.77	.62	.57	.61
4	*M*	3.17	3.37	3.43	3.40	3.33
	SD	.55	.59	.44	.52	.45
5	*M*	3.03	2.93	3.27	3.11	3.14
	SD	.54	.60	.49	.53	.48
>5	*M*	2.61	3.25	3.25	3.08	2.99
	SD	.47	.88	.70	.64	.49

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School Science Classes						
1	*M*	3.24	3.49	3.49	3.39	3.36
	SD	.58	.57	.51	.53	.51
2	*M*	3.19	3.27	3.45	3.32	3.33
	SD	.64	.75	.57	.58	.55
3	*M*	3.10	3.24	3.37	3.31	3.26
	SD	.55	.56	.42	.46	.39
4	*M*	3.06	3.21	3.29	3.35	3.26
	SD	.52	.56	.42	.41	.38
5	*M*	3.32	3.51	3.49	3.59	3.48
	SD	.42	.42	.33	.28	.30
>5	*M*	2.43	3.00	2.70	2.67	2.68
	SD	-	-	-	-	-
High School Technology Education Classes						
1	*M*	3.24	3.29	3.44	3.35	3.35
	SD	.57	.55	.48	.49	.46
2	*M*	3.09	3.29	3.45	3.28	3.27
	SD	.59	.52	.38	.42	.42
3	*M*	3.11	3.38	3.52	3.30	3.31
	SD	.46	.46	.35	.44	.37
4	*M*	3.16	3.30	3.39	3.25	3.26
	SD	.56	.61	.47	.51	.47
5	*M*	3.13	3.52	3.51	3.21	3.24
	SD	.49	.48	.37	.48	.41
>5	*M*	3.31	3.44	3.55	3.38	3.45
	SD	.51	.54	.36	.47	.39
High School Engineering Other than PLTW						
1	*M*	3.17	3.19	3.40	3.29	3.28
	SD	.50	.53	.45	.48	.42
2	*M*	3.02	3.14	3.38	3.41	3.30
	SD	.78	.70	.58	.48	.53
3	*M*	2.29	2.33	2.60	2.47	2.51
	SD	.88	1.22	1.17	1.04	1.07
4	*M*	3.23	3.00	3.24	3.22	3.26
	SD	.33	.41	.59	.46	.46
5	*M*	3.14	3.50	3.45	3.22	3.29
	SD	.40	.71	.64	-[.31	.50
>5	*M*	3.17	3.19	3.40	3.29	3.28
	SD	.50	.53	.45	.48	.42

(Continued)

Table J122 *Continued*

Sections		AID	MLT	CC	MFL	OAS
High School Other Classes						
1	*M*	3.10	3.19	3.28	3.24	3.21
	SD	.61	.60	.53	.60	.53
2	*M*	2.93	3.15	3.33	3.14	3.14
	SD	.48	.53	.42	.48	.38
3	*M*	3.16	3.23	3.40	3.37	3.34
	SD	.43	.50	.41	.41	.40
4	*M*	3.14	2.87	3.14	3.20	3.15
	SD	.63	.77	.58	.47	.56
5	*M*	3.29	3.58	3.65	3.58	3.50
	SD	.31	.42	.45	.40	.35
>5	*M*	3.38	3.67	3.65	3.46	3.50
	SD	.66	.42	.41	.47	.48

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J123
ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Gateway to Technology Classes Taught during 2011 Spring Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	4.13	6	.69	3.31	.003**
Within Groups	111.75	537	.21		
Total	115.87	543			

Note. **Significance at the *p*<.05 level.

Table J124
ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Intro to Engineering Design Classes Taught During 2011 Spring Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	2.36	5	..47	2.18	.055**
Within Groups	106.48	493	.22		
Total	108.83	498			

Note. **Significance at the *p*<.05 level.

Table J125

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of Digital Electronics Classes Taught During 2011 Spring Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	40.96	5	.57	1.76	.122**
Within Groups	98.44	192	.21		
Total	42.84	197			

Note. **Significance at the p<.05 level.

Table J126

ANOVA for Overall Teacher Self-Efficacy Means Based on Sections of PLTW: Engineering Design and Development Classes Taught During 2011 Spring Semester

	Sum of Squares	df	Mean Square	*F*	*p*
Between Groups	1.88	5	.37	1.76	.121**
Within Groups	40.96	192	.21		
Total	42.84	197			

Note. **Significance at the p<.05 level.

Table J127

Frequency Distribution Based on PLTW Certification Process

PLTW Certification Process	*N*	%
PLTW: Gateway to Technology		
Two week summer	285	24.85
Post-Secondary Courses	12	1.05
Not Certified	850	74.11
PLTW: Intro to Engineering Design		
Two week summer	647	56.41
Post-Secondary Courses	21	1.83
Not Certified	479	41.76
PLTW: Principles to Engineering		
Two week summer	490	42.72
Post-Secondary Courses	17	1.48
Not Certified	640	55.80
PLTW: Digital Electronics		
Two week summer	287	25.02
Post-Secondary Courses	26	2.27
Not Certified	834	72.71
PLTW: Computer Integrated Manufacturing		
Two week summer	137	11.94
Post-Secondary Courses	10	0.87
Not Certified	1000	87.18
PLTW: Civil Engineering and Architecture		
Two week summer	178	15.52
Post-Secondary Courses	11	0.96
Not Certified	958	83.52
PLTW: Biotechnical Engineering		
Two week summer	26	2.27
Post-Secondary Courses	2	0.17
Not Certified	1119	97.56
PLTW: Aerospace Engineering		
Two week summer	55	4.80
Post-Secondary Courses	1	0.09
Not Certified	1091	95.12

(Continued)

Table J127 *Continued*

PLTW Certification Process	*N*	%
PLTW: Engineering Design and Development		
Two week summer	172	15.00
Post-Secondary Courses	7	0.61
Not Certified	968	84.39
Number of Respondents	1147	
Number of Non-Respondents	10	

Table J128

Teacher Self-Efficacy Means Based on PLTW Certification Process (n = 1147)

Years		AID	MLT	CC	MFL	OAS
Gateway to Technology Two Week Summer Training	*M*	3.27	3.39	3.47	3.38	3.36
	SD	.52	.54	.41	.45	.42
Gateway to Technology Post-Secondary Classes	*M*	3.44	3.44	3.53	3.35	3.44
	SD	.46	.49	.37	.41	.37
Intro to Engineering Design Two Week Summer Training	*M*	3.16	3.34	3.44	3.34	3.32
	SD	.58	.59	.49	.52	.48
Intro to Engineering Design Post-Secondary Classes	*M*	3.29	3.37	3.48	3.42	3.42
	SD	.39	.60	.39	.49	.37
Principles to Engineering Two Week Summer Training	*M*	3.16	3.33	3.44	3.34	3.32
	SD	.57	.57	.48	.51	.47
Principles to Engineering Post-Secondary Classes	*M*	3.35	3.49	3.52	3.44	3.44
	SD	.52	.54	.49	.57	.50
Digital Electronics Two Week Summer Training	*M*	3.17	3.36	3.47	3.36	3.34
	SD	.57	.55	.43	.48	.45
Digital Electronics Post-Secondary Classes	*M*	3.30	3.38	3.51	3.41	3.42
	SD	.50	.48	.40	.48	.41

(Continued)

Table J128 *Continued*

Years		AID	MLT	CC	MFL	OAS
Computer Integrated Manufacturing Two Week Summer Training	*M*	3.25	3.43	3.51	3.39	3.39
	SD	.59	.57	.51	.52	.50
Computer Integrated Manufacturing Post-Secondary Classes	*M*	3.59	3.57	3.65	3.58	3.59
	SD	.37	.61	.34	.42	.33
Civil Engineering and Architecture Two Week Summer Training	*M*	3.17	3.39	3.49	3.36	3.35
	SD	.62	.59	.52	.55	.51
Civil Engineering and Architecture Post-Secondary Classes	*M*	3.25	3.73	3.71	3.73	3.58
	SD	.58	.58	.56	.54	.52
Biotechnical Engineering Two Week Summer Training	*M*	3.24	3.46	3.48	3.43	3.38
	SD	.69	.57	.41	.54	.50
Biotechnical Engineering Post-Secondary Classes	*M*	3.71	3.50	3.55	3.44	3.60
	SD	.40	.71	.35	.79	.48
Aerospace Engineering Two Week Summer Training	*M*	3.17	3.33	3.42	3.36	3.32
	SD	.56	.56	.46	.45	.44
Aerospace Engineering Post-Secondary Classes	*M*	4.00	4.00	3.80	4.00	3.94
	SD	-	-	-	-	-
Engineering Design and Development Two Week Summer Training	*M*	3.23	3.46	3.53	3.42	3.40
	SD	.56	.49	.41	.44	.42
Engineering Design and Development Post-Secondary Classes	*M*	3.39	3.43	3.54	3.56	3.55
	SD	.40	.42	.20	.38	.24

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J129

Hours of PLTW On-line Support Received per Month

Hours	*N*	%
0	368	32.17%
1	348	30.42%
2	199	17.40%
3	61	5.33%
4	64	5.59%
5	43	3.76%
6	18	1.57%
7	2	0.17%
8	10	0.87%
9	2	0.17%
10	8	0.70%
> 10	21	1.84%
Number of Respondents	1144	
Number of Non-Respondents	13	

Table J130

Teacher Self-Efficacy Means Based on Hours of PLTW On-line Support Received per Month (n = 1144)

Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.20	3.40	3.46	3.38	3.34
	SD	.57	.57	.48	.51	.48
1	*M*	3.18	3.36	3.46	3.35	3.33
	SD	.56	.54	.45	.47	.45
2	*M*	3.18	3.36	3.46	3.38	3.34
	SD	.54	.54	.44	.47	.44
3	*M*	3.22	3.36	3.48	3.36	3.35
	SD	.60	.61	.48	.49	.49
4	*M*	3.05	3.23	3.34	3.25	3.21
	SD	.51	.48	.42	.42	.39
5	*M*	3.28	3.25	3.45	3.34	3.36
	SD	.55	.71	.54	.60	.54
6	*M*	3.24	3.37	3.58	3.38	3.44
	SD	.61	.50	.36	.53	.42
7	*M*	3.00	3.67	3.50	3.44	3.32
	SD	.40	.00	.28	.47	.36
8	*M*	3.31	3.60	3.61	3.46	3.44
	SD	.61	.44	.43	.45	.50

(Continued)

Table J130 *Continued*

Hours		AID	MLT	CC	MFL	OAS
9	*M*	3.57	3.00	3.40	3.22	3.45
	SD	-	-	-	-	-
10	*M*	3.36	3.33	3.46	3.38	3.38
	SD	.66	.69	.45	.63	.56
>10	*M*	3.49	3.60	3.72	3.58	3.60
	SD	.49	.55	.36	.40	.39

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J131
Hours of PLTW On-line Support Provided per Month

Hours	*N*	%
0	804	70.77%
1	218	19.19%
2	44	3.87%
3	19	1.67%
4	14	1.23%
5	11	0.97%
6	5	0.44%
7	1	0.09%
8	3	0.26%
9	0	0.00%
10	5	0.44%
> 10	12	1.06%
Number of Respondents	1136	
Number of Non-Respondents	21	

Table J132

Teacher Self-Efficacy Means Based on Hours of PLTW On-line Support Provided per Month (n = 1136)

Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.14	3.33	3.42	3.33	3.30
	SD	.56	.57	.46	.48	.45
1	*M*	3.25	3.44	3.52	3.41	3.40
	SD	.55	.56	.45	.49	.45
2	*M*	3.36	3.46	3.56	3.51	3.48
	SD	.50	.46	.38	.41	.39
3	*M*	3.42	3.54	3.56	3.54	3.52
	SD	.56	.52	.50	.49	.47
4	*M*	3.38	3.50	3.59	3.49	3.48
	SD	.68	.77	.73	.78	.70
5	*M*	3.45	3.64	3.59	3.55	3.52
	SD	.54	.41	.33	.43	.37
6	*M*	3.34	3.53	3.60	3.44	3.48
	SD	.62	.38	.44	.54	.49
7	*M*	2.14	3.00	2.70	2.67	2.48
	SD	.	.	.	.	.
8	*M*	3.48	3.67	3.70	3.67	3.59
	SD	.58	.58	.52	.58	.60
9	*M*	-	-	-	-	-
	SD	-	-	-	-	-
10	*M*	3.57	3.60	3.62	3.53	3.59
	SD	.59	.55	.52	.64	.57
>10	*M*	3.69	3.70	3.78	3.61	3.69
	SD	.41	.41	.22	.46	.35

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J133

Hours per Month Discussing PLTW Issues

Hours	*N*	%
0	578	50.84%
1	277	24.36%
2	149	13.10%
3	33	2.90%
4	31	2.73%
5	16	1.41%
6	16	1.41%
7	1	0.09%
8	3	0.26%
9	0	0.00%
10	3	0.26%
> 10	30	2.64%
Number of Respondents	1137	
Number of Non-Respondents	20	

Table J134

Teacher Self-Efficacy Means Based on Hours per Month Discussing PLTW Issues (n = 1137)

Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.12	3.32	3.41	3.33	3.29
	SD	.57	.57	.47	.49	.46
1	*M*	3.24	3.38	3.46	3.35	3.35
	SD	.52	.56	.46	.49	.45
2	*M*	3.22	3.44	3.51	3.40	3.38
	SD	.56	.56	.45	.50	.46
3	*M*	3.38	3.54	3.63	3.57	3.53
	SD	.51	.42	.38	.43	.41
4	*M*	3.11	3.30	3.54	3.40	3.38
	SD	.57	.47	.31	.39	.37
5	*M*	3.17	3.19	3.41	3.32	3.33
	SD	.59	.63	.54	.59	.53
6	*M*	3.34	3.44	3.50	3.38	3.40
	SD	.49	.59	.43	.36	.35
7	*M*	3.57	3.00	3.00	3.11	3.26
	SD	-	-	-	-	-
8	*M*	3.43	3.83	3.95	3.72	3.76
	SD	.20	.24	.07	.39	.16
9	*M*	-	-	-	-	-
	SD	-	-	-	-	-

(*Continued)*

Table J134 *Continued*

Hours		AID	MLT	CC	MFL	OAS
10	*M*	4.00	4.00	4.00	4.00	4.00
	SD	.00	.00	.00	.00	.00
>10	*M*	3.64	3.62	3.68	3.68	3.65
	SD	.46	.50	.36	.39	.36

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.

Table J135
Hours per Year Spent with PLTW Partnership Team

Hours	*N*	%
0	298	26.03%
1	124	10.83%
2	162	14.15%
3	100	8.73%
4	152	13.28%
5	38	3.32%
6	65	5.68%
7	6	0.52%
8	33	2.88%
9	5	0.44%
10	28	2.45%
> 10	134	11.70%
Number of Respondents	1145	
Number of Non-Respondents	12	

Table J136

Teacher Self-Efficacy Means Based on Hours per Year Spent with PLTW Partnership Team (n = 1145)

Hours		AID	MLT	CC	MFL	OAS
0	*M*	3.16	3.37	3.45	3.36	3.32
	SD	.58	.59	.47	.51	.47
1	*M*	3.15	3.33	3.40	3.30	3.29
	SD	.61	.57	.49	.51	.49
2	*M*	3.20	3.35	3.42	3.34	3.32
	SD	.56	.58	.48	.49	.46
3	*M*	3.06	3.28	3.39	3.28	3.25
	SD	.50	.52	.45	.49	.44
4	*M*	3.15	3.36	3.44	3.33	3.31
	SD	.54	.51	.45	.46	.44
5	*M*	3.23	3.40	3.52	3.37	3.39
	SD	.53	.52	.37	.44	.40
6	*M*	3.31	3.49	3.59	3.50	3.47
	SD	.54	.49	.35	.40	.39
7	*M*	2.86	3.11	3.25	2.98	3.04
	SD	.33	.27	.33	.53	.30
8	*M*	3.25	3.21	3.41	3.31	3.32
	SD	.64	.76	.53	.58	.55
9	*M*	3.20	3.47	3.50	3.49	3.41
	SD	.54	.73	.60	.44	.45
10	*M*	3.36	3.40	3.52	3.47	3.46
	SD	.43	.52	.43	.48	.40
>10	*M*	3.35	3.47	3.57	3.49	3.48
	SD	.54	.53	.45	.47	.44

Note. AID: Accommodating Individual Differences Self-Efficacy; MLR: Managing Learning Routine Self-Efficacy; CC: Maintaining a Positive Classroom Climate Self-Efficacy; MFL: Monitoring and Feedback for Learning Self-Efficacy; and OSE: Overall Self-Efficacy.