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Perceptions of Indiana's Engineering/Technology Education Classroom Teachers as Measured by the Characteristics of Technology Education Survey

For the degree of Doctor of Philosophy

Is approved by the final examining committee:

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PERCEPTIONS OF INDIANA'S ENGINEERING/TECHNOLOGY EDUCATION CLASSROOM TEACHERS AS MEASURED BY THE CHARACTERISTICS OF TECHNOLOGY EDUCATION SURVEY

A Dissertation

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ABSTRACT

Rogers, Steven E. Ph.D., Purdue University, December 2012. Perceptions of Indiana's Engineering/Technology Education Classroom Teachers as Measured by the Characteristics of Technology Education Survey. Major Professor: Dr. Matthew P. Stephens.

The purpose of this study was to determine Engineering/Technology Education (ETE) teachers' perceptions of Project Lead The Way's (PLTW) pre-engineering program in the state of Indiana utilizing the Characteristics of Technology Education Survey (CTES) (Daugherty, Hill, & Wicklein, 1996). The study focused on the perceptions of teachers who were and were not teaching PLTW's pre-engineering curriculum as they related to curriculum content, teaching methodology, curriculum integration, and fit of curriculum in school environment. Two hundred and eighty two or 51.3% of Indiana high school ETE teachers responded to the 46 question CTES. Analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) were conducted to test for significance. The study found no significant differences in the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program.

CHAPTER 1 INTRODUCTION

1.1 Introduction

Pre-engineering programs in high schools were non-existent in America prior to 1997. However, as the Engineering/Technology Education (ETE) profession has evolved, pre-engineering education has become a major curricular force in all 50 states (Project Lead The Way, 2009). In 2004, collegiate and secondary level engineering and technology education leaders were calling for changes to be made to high school curriculum (Dearing and Daugherty). Students were not being prepared properly to graduate and enter into an engineering school with the right skill set. High schools needed a way to prepare these students. Many high school teachers realized that they could offer a pre-engineering program that allowed students to explore engineering at the high school level and prepare them with the skills they needed (Thilmany, 2003).

Recent choices of pre-engineering curriculums in a high school were *Engineering by Design* from the International Technology and Engineering Education Association (ITEEA) (2009), Ford's *Partnership for Advanced Studies* (2009), and Project Lead The Way's (PLTW) *Pre-engineering Curriculum* (2009). PLTW is the nation's largest pre-engineering curriculum program. PLTW offers middle and high school curriculum and a direct link to collegiate engineering programs. PLTW's pre-engineering program experienced rapid growth from 1997 when it was launched in upstate New York as an independent non-profit organization. In 1997, 12 high schools participated, but by 2009 approximately 1,500 high and middle schools had over 150,000 students enrolled in PLTW programs (PLTW, 2009).

This growth in pre-engineering programs affected teachers' attitudes and perceptions towards engineering. In 2003, McVearry stated that teacher perceptions and attitudes toward pre-engineering education became more favorable. States that placed a high emphasis on PLTW pre-engineering programs saw an increase in the number of students who entered a collegiate engineering program (McVearry).

Indiana was one state that placed an increased emphasis on PLTW's pre-engineering program. According to the Indiana Department of Education (IDOE, 2012), Indiana PLTW programs have reached 632 schools impacting over 25,000 students. PLTW's pre-engineering curriculum was placed in the engineering and technology education discipline by the IDOE. The ETE designation is for state funding, course registration, and teacher licensure.

"Research in Indiana indicated that technology education teachers have embraced pre-engineering education as a very valuable component of technology education" (Rogers, 2005, p. 18). Rogers further stated "that both PLTW teachers and non-PLTW teachers view pre-engineering education as a valuable component of technology education. However, PLTW teachers were nearly twice as likely to rate pre-engineering as a very valuable component as were non-PLTW teachers" (Rogers, 2005, p. 19).

1.2 Statement of the Problem

Previous research concluded that over 135 Indiana high schools were offering PLTW's pre-engineering courses in 2005 (Rogers). According to Rogers, however, these

ETE teachers have different perceptions of their ETE programs. At the time of this study, there was not a body of knowledge examining the differences surrounding these perceptions. This study examined the different perceptions between ETE teachers who were teaching using PLTW's pre-engineering curriculum and those ETE teachers who were not teaching PLTW's pre-engineering curriculum.

1.3 Purpose of the Study

The purpose of this study was to determine ETE teachers' perceptions of PLTW's pre-engineering program in the state of Indiana by utilizing the Daugherty, Hill, and Wicklein's (1996) Characteristics of Technology Education Survey (CTES). This study examined two groups of ETE teachers. Those who were teaching PLTW's pre-engineering curriculum; and those and who were not teaching PLTW's pre-engineering curriculum. The perceptions of each group were examined on the basis of curriculum content, teaching methodology, program integration, and course fit.

1.4 Significance of the Study

The benefits of determining the ETE teachers' perceptions of pre-engineering programs were threefold. First, the study allowed the researcher to identify which of the four areas (curriculum content, teaching methodology, program integration, and course fit within school environment) has been perceived differently by teachers as it related to pre-engineering education. Secondly, the study provided ETE researchers with a description of characteristics of non-PLTW teachers. The third benefit was the additional research topics developed in the ETE career field.

1.5 Scope of the Study

The scope of this study was limited to high school ETE teachers in the state of Indiana. However, the methods of this study could be far-reaching. According to PLTW (2009), there were ETE instructors in 49 other states that had pre-engineering programs that are affected by ETE teachers' perceptions. The methods of this study are adaptable to other states.

1.6 Rationale for the Study

There had been little written about the perceptions of ETE teachers and pre-engineering specifically when it came to the evaluation of ETE programs. Past studies were conducted using the CTES on technology education programs (Daugherty, Hill, & Wicklein, 1996). However, no studies were conducted utilizing the CTES to examine a pre-engineering program. Examination of the responses of the two groups of ETE teachers on the CTES in this study provided new information.

1.7 Research Questions

This study proposed to answer the following four questions based on a study conducted by Daugherty, Hill, and Wicklein (1996):

1. Is there a significant difference in the perception of the ETE curriculum content between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?

2. Is there a significant difference in the perception of ETE teaching methodology between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?
3. Is there a significant difference in the perception of the integration of ETE with other school subjects between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?
4. Is there a significant difference in the perception of the "fit" of ETE within the total school environment between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?

1.8 Null Hypothesis

The research questions (see Section 1.7) furnished the basis for the testing of the following four null hypotheses:

H_o1: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES regarding curriculum content.

H_o2: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES regarding the teaching methodology.

H_o3: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES regarding the integration with other school subjects.

H_o4: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES regarding the "fit" within the total school environment.

1.9 Definition of Terms

For the purpose of this study, these terms were defined as follows:

Engineering – "Engineering is the art of applying scientific and mathematical principles, experience, judgment, and common sense to make things that benefit people. It is the process of producing a technical product or system to meet a specific need" (American Society for Engineering Education, 2010).

Engineering and Technology Education (ETE) - An evolution of technology education, primarily at grade levels 6-12 that attempts to teach students to become technologically literate, with a focus on engineering design (ITEEA, 2009).

Industrial Arts – "A comprehensive educational program concerned with technology, its evolution, utilization, and significance; with industry, its organization, personnel, systems, techniques, resources, and products; and their social/cultural impact" (Foster, 1994, p.18).

Perceptions – Teachers' perceptions were described as "a component of the teachers' belief system they called beliefs about subject matter" (Grossman, Wilson, & Shulman, 1989, p.23).

Pre-engineering- "Coursework or subjects that draw content from the work of engineers, and that promise engineering careers as likely futures of the students who pursue them" (Lewis, 2004, p.22).

Technological literacy: "One's ability to use, manage, assess, and understand technology" (ITEEA, 2000/2002, p.9).

Technology Education (TE)- "An educational program that helps people develop an understanding and competence in designing, producing, and using technology products and systems and in assessing the appropriateness of technological actions" (Wright, Israel, & Lauda, 1993, p.4).

1.10 Assumptions of the Study

This study assumed that surveying of Indiana ETE teachers via a web based program was the most economical and efficient method of gaining insight in a timely manner regarding their perceptions of pre-engineering education. It was assumed the email addresses of every current secondary ETE educator in Indiana were listed correctly in the IDOE database. It was also assumed each educator had access to the email account where the survey was sent and to the Internet where the survey took place. This study also assumed that the response rate for the survey may have been elevated due to the fact that the researcher and researcher's father were well known in the ETE field in the state of Indiana.

1.11 Limitations of the Study

This study was limited to the Indiana ETE teachers instructing grades 9-12 that were in the IDOE database. The accuracy in the IDOE database of these ETE teachers' email addresses was also a limitation. An additional limitation was the lack of female teachers in Indiana. At the time of the study only 18 of the 608 ETE teachers were female. This prevented the researcher from considering gender as a variable.

1.12 Summary

Chapter One presented a research study that posed four questions (Section 1.7) regarding the perceptions of ETE teachers in the state of Indiana. Curriculum content, teaching methodology, integration, and fit of curriculum content were the basis of these perceptions. Included in this chapter were the scope, rationale, definitions, assumptions, and limitations of the study.

CHAPTER 2 REVIEW OF LITERATURE

2.1 Introduction

The purpose of this study was to determine ETE teacher's perceptions of PLTW's pre-engineering program in the state of Indiana by utilizing the CTES (Daugherty, Hill, &Wicklein, 1996). The purpose of this chapter is to present a report on the results of a comprehensive literature review.

The review of the literature noted factors that have contributed to the formation of perceptions of the field of ETE. This review included the history of the field and its transition from manual arts to ETE, the different curriculum content of technology education and pre-engineering programs, the benefits of pre-engineering education, a summary of studies of perceptions in technology education, survey reliability, and survey scale selection.

2.2 Procedures for the Review of Literature

The review of literature was conducted during 2008 to 2010 and updated in 2012. Relevant articles and books published between 1887 and 2011 were reviewed for the literature search. The OVID version of the ERIC database was used through the Purdue University libraries web page at HTTP://WWW.LIB.PURDUE.EDU. The ERIC database, sponsored by the U.S. Department of Education, is the largest database in the field of education. It indexes both journal articles and ERIC documents, with most documents after 1997 being available in full text.

While using all of the above mentioned databases, the literary search used the following primary descriptors: technology, industrial, education, engineering, pre-engineering, history, perceptions, survey, study, Indiana, teachers, benefits, methodology, curriculum, curricula, and integration. These search words were used in different combinations with one another in various searches. The words were also used in a variety of ways when advanced searches were available that gave options to search for a title or subject matter that must contain certain words or should contain certain words.

2.3 Manual Training to Industrial Arts

The earliest type of formal training in technical skills was based on the apprenticeship system that dated back a millennium (Snyder, 2004). Students agreed to work with a master craftsman for seven years in exchange for learning the secrets of the trade. At the completion of their apprenticeship, the young person would be admitted to a local craft guild as a journeyman. After several years of moving around from village to village as a journeyman he could choose to produce a "masterpiece" (Lewis, 2005). The student was only granted the name of master craftsman after his piece of work was judged to be a masterpiece.

The first major movement in formalizing technical skills was a program in Russia used to train engineers who worked for the Russian government. The Russian system established by Victor Della Voss started in 1868 (Pesesky, 2003). The Russian system used only metal and wood as materials in their training. Students studying woodworking would progress every three years from joinery to cabinet-making. It would take an apprentice over 6 years to complete the system (Pesesky, 2003).

At the Centennial Exposition in 1876, Della Voss demonstrated the Russian system to America. President John D. Runkle of Massachusetts Institute of Technology (MIT), quickly realized the training system had potential and used it as a base for the School of Mechanic Arts of MIT. Others also saw the potential like Calvin M. Woodward. He opened the St. Louis Manual Training School in 1879 using the Russian system as his curriculum (Foster, 1996).

Woodward's manual training, as it was termed at the time, had students at the simplest levels learning the correct use of tools. The emphasis was on hands-on work and learning how to use the tools of the shop (Foster, 1996). This pattern was predominating in the industrial arts curriculum, where additions to the curriculum did not follow a logical pattern but were add to support new processes and materials (Zuga, 1997).

Manual training was slowly replaced at the beginning of the 20th Century with manual arts. For many years, the two names were used interchangeably (Foster, 1996). Manual arts gradually evolved into a philosophy geared towards the general education population. The use of vocational tools was emphasized less in manual arts than it was in manual training. In manual arts, more emphasis was put on the creation of individual projects and less emphasis was put on learning the details of tool use (Foster).

The passage of the federal 1917 Smith-Hughes Vocational Act (Foster, 1995) introduced a new term for technology education, *industrial arts*. The Smith-Hughes Vocational Act provided federal funding for vocational programs in public schools (Foster). The law stipulated in detail the vocational character of the courses to be taught.

Industrial arts was the general education name that eventually replaced manual arts (Snyder, 2004).

The 1917 Smith-Hughes Vocational Act defined a split within the industrial education groups. The path for general education would be defined going forward as industrial arts or industrial education; while the path of defined vocational training would be called vocational education. However, overlapping of industrial teachers became a problem that caused confusion when trying to differentiate between vocational and industrial education. According to Zuga (1997), it became a common practice to group together all of the industrial teachers. Vocational education teachers and industrial arts teachers were usually trained together. Industrial arts students often were educated using the same courses as vocational education students (Zuga).

Texts used to prepare industrial arts teachers were the same texts used to prepare students to teach vocational education (Zuga, 1997). This resulted in many students that did not understand the differences between industrial and vocational education. These students were often not able to create projects or curriculum which was anything but a simple version of a project built in vocational education classes (Synder, 2004).

Federal funds have been available to fund vocational programs since 1917 (Foster, 1995). Because of this funding, industrial programs at both the high school and college level have remained similar to those levels of vocational training. This blurring of the line between vocational and industrial/technological education has paid off for teachers in terms of government funding for new classroom equipment and supplies, supported teachers' salaries, and increased reimbursements for teacher training (Zuga, 1997).

When reading varied histories of technology education it became clear that there was not a linear path from manual training to manual arts to industrial arts with an offshoot of vocational education (Foster, 1995; Snyder, 2004). Snyder tried to help clear up the confusion among the three methods of teaching technology education at the beginning of the century: manual arts, manual training, and vocational arts. Snyder said, “the emphasis of all these programs was on 'learning by doing,' but the focus of the content was always based in, or on, technology. Technology education evolved from, but is not limited to, this strong tradition of hands-on learning” (Snyder, p. 23).

2.4 Industrial Arts to Engineering/Technology Education

This learn-by-doing approach continued with little or no change until the late 1950s. It was then that many teachers had grown uncomfortable with industrial arts as it was not adapting itself well with the rapid growth in technology (Towers, Lux, & Ray, 1966). These teachers looked for ways to experiment and implement new ways of teaching industrial arts.

Delmar Olson (1957), a graduate student at The Ohio State University, published his dissertation organizing technology by content. Concerning the organization of industrial arts content, Olson (1963) stated, "in search of the technology for industrial arts subject matter, the first step is to look at industry itself" (p. 61). Olson focused on industry as the way to categorize industrial subject matter. He suggested seven content areas including: “manufacturing, construction, power, transportation, electronics, service industries, and industrial research and management” (Olson, p. 62).

Other proposals with a new focus on technology appeared with *A Curriculum to Reflect Technology* (Warner, Gary, Gerbracht, Gilbert, Lisack, Klientjes, & Phillips, 1965). Faculty at The Ohio State University, lead by William Warner, understood the predicament of transforming an industrial arts curriculum from crafts to technology. The faculty recommended that the technology content be organized around six topics: management, communications, construction, power, transportation, and manufacturing (Warner et al.).

Warner (et al., 1965) and Olson's (1957) research lead to a period of exploration, and discourse as all parties were trying new and innovative ways to improve industrial arts (Cochran, 1970). Multiple curriculum projects and programs were started during this time. Two of the most well known curriculum programs of the late 1960s and early 1970s were the Industrial Arts Curriculum Project (IACP) and the Maryland Plan (Lux, 2002).

The Maryland Plan (Maley, 1972):

> Was the first curriculum development plan for industrial arts that took the focus off the content areas in order to emphasize 1) technology, its evolution, use and significance, 2) industry, its organization, materials, occupations, processes, and products, and 3) problems and benefits that result from technological and industrial activities. (Zuga & Cardon, 1999, p. 147)

Donald Lux (2002) and Willis Ray, both of The Ohio State University, served as the co-directors for the IACP. The curriculum program was setup for junior high students. It consisted of two courses, *World of Manufacturing* and W*orld of*

Construction. It was supported with detailed curriculum, projects, and textbooks. According to Lux (2002), IACP accelerated the modernization of industrial arts.

The debate over curriculum lasted until the 1980s, when state leaders in industrial arts from West Virginia developed a plan to gather many industrial arts leaders from around the country together to develop a state plan (Snyder & Hales, 1981). This plan, the Jackson's Mill Industrial Arts Curriculum Theory, was a compromise for the leaders of industrial arts. Jackson Mill ended the discourse among the different plans and provided a focus for moving forward (Snyder & Hales, 1981).

While many programs were created prior to Jackson Mill (Cochran, 1970), the Jackson's Mill plan showcased the effort of Paul DeVore with his conceptualization for the study of technology (1964), Donald Lux, Willis Ray, and Edward Towers on the IACP (1966), and Donald Maley on the Maryland Plan (1973). The International Technology Education Association (ITEA) began to endorse teaching technology as suggested by the Jackson's Mill compromise (ITEA, 1996).

About 15 years later, William Wulf, in conjunction with the ITEA received National Science Foundation (NSF) funding to create standards very much like existing science and math standards. Prior to the release of the standards, *Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA, 1996) was published. This document discussed the concepts of technological literacy and a structure on how to teach technology. In 2000, the *Standards for Technological Literacy (STL): Content for the Study of Technology* were released (ITEA). With a decidedly new emphasis, the STL's marked a beginning to transition the practice of technology educators. These educators were to now put emphasis on design, interrelationships with society, and the nature of technology (ITEA, 2000).

With the growth of focus on technological literacy, Wicklein (2006) argued that technology education should embrace an engineering focus in their curriculum. He stated that a focus on engineering would be helpful in this area because “educators continue to seek a consensus of curriculum content that can steer their classes and programs along an appropriate path that supports and meets the *Standards for Technological Literacy* (ITEA, 2000), while at the same time creates an instructional model that attracts and motivates students from all academic levels” (Wicklein, 2006, p. 27).

The content debate continues as the field moves from technology education to ETE. The state of Indiana recently changed its name from technology education to ETE to better reflect its engineering component (IDOE, 2009). This hopefully will help the identity crisis that technology education currently suffers. Rogers (2005) discussed how technology education suffers because the general public knows very little about the discipline, with over half of the public perceiving the profession as dealing with computers only. Engineering is held in much higher regard as opposed to technology education, even though technology education currently has the advantage of being a part of the curriculum in most schools today (Wicklein, 2006). Because engineering is not a school discipline, technology education programs were incorporating pre-engineering as one of its own. The addition of the engineering focus to the existing technology education programs may clarify any confusion the general public may have regarding the technology education discipline, but it leads to different dynamics in the current ETE programs (Rogers, 2005).

2.5 Focus of Technology Education and Pre-Engineering Education

The core beliefs of technology education were accepted universally. According to the ITEA:

> Technology education is defined as problem-based learning utilizing math, science and technology principles. The study of technology involves: (a) designing, developing, and utilizing technological systems, (b) open-ended, problem-based design activities, (c) cognitive, manipulative, and effective learning strategies, (d) applying technological knowledge and processes to real world experiences using up-to-date resources, (e) working individually as well as in a team to solve problems. (ITEA, 2002, p. 9)

These core beliefs were recognized in technology education, but what were the core beliefs of pre-engineering education? Lewis stated that pre-engineering is "coursework or subjects that draw content from the work of engineers, and that promise engineering careers as likely futures of the students who pursue them" (Lewis, 2004, p.22). Schools use a career pathway or course sequence that provides students with defined path for enrollment in collegiate engineering programs, upon graduation from high school (Lewis).

According to PLTW (2009), the focus of pre-engineering is to increase the student engagement and enrollment in collegiate engineering programs by providing high school students with engaging curriculum. Students who complete PLTW's pre-engineering program:

> (a) Understand technology as a problem-solving tool, (b) understand scientific process, engineering problem solving and the application of technology, (c) understand how technological systems work with other systems, (d) use mathematics knowledge and skills in solving problems, (e) communicate effectively through reading, writing, listening and speaking, (f) work effectively with others. (Southern Regional Education Board, 2001, p. 6)

These definitions show that both pre-engineering education and technology education have similar goals. However, they both have a somewhat dissimilar emphasis. Pre-engineering education places emphasis on preparing students for collegiate engineering programs. Technology education places emphasis on preparing technologically literate students for all career fields.

2.6 Benefits of Pre-Engineering Education

The first benefit of pre-engineering education is the perceived view of engineering as essential. According to Lewis (2004), current technology education courses and programs were perceived as nonessential in most high schools. Technology education programs were vulnerable in high schools where their courses were elective. Also these course were vulnerable in states, including Indiana, where technology education is not required for graduation from high school (IDOE, 2009).

Current curriculum in technology education has never really been able to succinctly inform any groups including students, administrators, and parents, of the goals of ETE high school programs (Lewis, 2004). The general public still refers to the field as "shop class." Most often, technology education is misconstrued for information technology or computer technology. However, according to Rogers (2005), most understand the word "engineering" and what work engineers complete. Pre-engineering provided validity to technology education by being able to discuss with students, administrators, or teachers what was being taught.

The second benefit of pre-engineering education points towards technological literacy. Technological literacy, as articulated in the *Standards for Technological Literacy* (ITEA, 2000/2002), and *Technically Speaking* (Pearson & Young, 2002), should be exploited as a thread around which technology education and pre-engineering may build a consequential relationship (Pearson, 2004). If the outcome of technology education is to prepare technologically literate students for all career fields, then having students prepared for a collegiate engineering program would classify as technological literacy.

One such pre-engineering program that high schools were now offering to help prepare students to be technologically literate for college is PLTW, which provided pre-engineering course curriculum for high school students. PLTW offers middle and high school curriculum and a direct link to collegiate engineering programs (PLTW, 2009). PLTW encourages students with passion for science and math to take PLTW and explore career possibilities (PLTW). Students who develop a connection to pre-engineering can continue in the program and complete up to eight different pre-engineering courses. Students who complete five or more pre-engineering courses will have become technologically literate to enter an engineering program (PLTW).

The third and final benefit of technology education adding pre-engineering education was the increased academic rigor and relevance. Instructors in schools had to increase academic rigor and relevance in their classrooms (Blais, 2004). The passage of *No Child Left Behind Act* (PL 107-110, 2001) required schools to focus on their students' "academic" record. Incorporating pre-engineering into ETE departments provided schools the opportunity to teach high academic rigor and relevant courses (Lewis, 2004).

According to Blais (2004), former Executive Director for PLTW, the pre-engineering courses were built upon the concepts and framework of rigor and relevance. Blais used examples comparing current technology education classes to current PLTW classes. The technology education class might be offering: "Design a beverage container that can be used by students while they were studying. Use good design criteria of function and aesthetic value" (Blais, 2004, p. 10). However in a PLTW course the problem might be more like:

> (a) Design a beverage container that will hold 12 fluid ounces, (b) sketch the top view and a front cross-sectional view of the container, (c) show the correct dimensions on the sketch needed to acquire 12 fluid ounces (show all your math calculations), and (d) use the computer design tool to apply good design criteria of function and aesthetic value to communicate the solution to this problem. (Blais, 2004, p.12)

Modern classes' in technology education were not offering any rigor or relevance (Wicklein, 1997). According to Wicklein:

> Current modes of delivering technology education curriculum activate certain aspects of learning theory but often come up short from delivering the total package. The modular curriculum which is so pervasive within the field today begins to address collaborative, "authentic" real world learning opportunities;

> however, it tends to be restrictive (limited in scope, collaboration, and sequence), disconnected (limited in transfer potential and unrealistic), and lacking a reality based learning context (hypothetically abstract). (p. 73-74)

However, high rigor and relevance is prevalent in today's pre-engineering classrooms. The challenges that students face in pre-engineering classrooms were sequenced, real world and rooted in high math and science. Pre-engineering provides the real world applications that are currently missing in technology education (Wicklein).

2.7 Studies Regarding Perceptions

The following studies examined the various perceptions of groups connected with technology education, specifically: students, teachers, leaders in technology education, teachers of other disciplines, administration, counselors, and parents. In 1993, Wicklein used a modified Delphi technique to identify problems and critical issues in technology education. The Delphi study used 25 panelists consisting of collegiate supervisors and administrators, teacher educators, and secondary classroom teachers. This panel came up with 580 items, which were then divided into present and future groups, with each group sub divided into issues and problems (Wicklein, 1993).

Of the top five results, both present and future, eight resulted from problems in the perception of the nature of technology education (Wicklein, 1993). Under the present problems category, inadequate marketing and the public relations of technology education, ranked first. The inaccurate understanding and lack of support, of technology education, by counselors and administrators, ranked fourth. The insufficient monetary support for technology education was ranked fifth (Wicklein).

Jones, Womble, and Searcy (1996), and Boser, Palmer, and Daugherty (1998) are two studies that examined the perceptions of students toward technology related fields. Jones et al. conducted research into urban student's perceptions in regards to the value of trade and industrial classes. The population was composed of all secondary students who lived in the southeast of the United States and attended a large urban school district. The sample was 284 students, 53.7% female and 46.3% male. Most classes in this district utilized the "cluster approach." Courses offered included: automotive technology, auto body, construction, cosmetology, and drafting. A number of the programs were industry certified (Jones et al.).

According to Jones et al. (1996), out of the 284 students surveyed, 232 questionnaires were returned. Two factors summarized the results: the educational value of the course as perceived by the student and individual meaning of the class to the student (Jones et al., 1996). The first factor measured the how much the course would provide the student career information and prepare them for employment. The second factor measured the students' perceptions of the importance of trade and industrial class to their daily lives (Jones et al.).

The results suggested that the educational level of their parents, why they took the course, and their graduation plans, influenced students' perceptions of trade and industrial courses (Jones et al., 1996). Students who were preparing for college, whether a two year, a vocational college, or a four year college, saw a relationship between the trade and industrial courses and what they would be doing in the future. Similarly, students whose parents' education extended beyond high school had a positive individual meaning of the trade and industry classes (Jones et al.).

Boser, Palmer, and Daugherty (1988) also studied the perceptions of students. They used the *Pupils' Attitude Towards Technology USA Instrument* (PATT-USA) (Bame, Dugger, de Vries, & McBee, 1987) to examine students' attitudes in three areas. Boser et al., were first concerned whether or not students' attitudes change when they take part in technology education classes. Secondly, they looked to see if there were attitude differences in the females verses the male students, as has been seen in other PATT-USA studies. Thirdly, they questioned if there were any differences in perceptions of the students towards the changes in the four different teaching methodologies normally used in middle school technology education. The four teaching methodologies were the problem solving method, the integrated method, the industrial arts method, and the modular method (Boser et al., 1988).

The population of Bame et al. (1987) study consisted of central Illinois and Chicago area middle school students. A pre-test and a post-test were administered. Students were then given a nine-week curriculum in technology education. According to Bame, students' interest in technology was not altered after completing the course. However, students did have a reduced belief that working with technology was difficult. Bame et al. also found that the attitude responses of male and female students were significantly different. Female students saw technology education as an activity for both genders and also found it to be less interesting than their male counterparts (Bame et al.).

The students who participated did not understand the content of technology education on either the pre- or post-tests. Student's technological literacy understanding showed no change in growth over the program (Bame et al., 1987). The instructional approach in this study did not significantly affect student's attitudes. The students' concept's and attitudes of technology were consistent with PATT-USA and PATT studies that had been previously conducted (Bame et al.).

The next six studies examined the possible differences in the perceptions of technology education teachers and other general education teachers, administrators, and counselors. Daugherty, Hill, and Wicklein, (1996) conducted research into the perceptions of technology teachers, administrators and guidance counselors. The research that was conducted attempted to determine whether counselors, teachers, and principals agreed about certain characteristics of technology education.

2.8 Tool Development

The rationale for Daugherty, Hill, and Wicklein's (1996) study was that until every member in the technology education field had a clear understand of its purpose, new curriculum could not be implemented effectively. The researchers first asked if there is a significant difference between technology teachers, principals and counselors' responses as measured by the CTES. The second purpose was to ask what the nature of the differences were, if any (Daugherty et al.).

The sample for Daugherty, Hill, and Wicklein 1996 study consisted technology education teachers, counselors, and principals at the schools where the teachers taught. Exemplary teachers provided the foundation in the perceived status of technology. The teachers were defined through the use of the following five criteria. (1) The instructor must be currently teaching in an outstanding technology education program. (2) They were required to have three years of classroom technology education teaching experience. (3) They must have created previous curriculum in technology education. (4) Their peers must have recognized them as a leader of technology education in their state. (5) They must also have been recognized for innovation by their peers (Daugherty et al.).

Principals and counselors were sampled because they were considered to be the most important factor in whether a technology education program was successful (Daugherty et al., 1996). When the responses to the CTES were examined, general agreement was found between groups of teachers curriculum content, methodology, integration, and environmental fit (Daugherty et al.).

Daugherty and Wicklein (1993) acknowledged some confusion outside of the field of technology education as to what characteristics exemplify technology education. They noted this appeared particularly true in the disciplines of mathematics and science. The purpose of their study was to clarify perceived characteristics associated within technology education as determined by technology, science, and math teachers. The outcomes of their study were important because integration of technology education with other subjects cannot occur without a clear purpose by all parties involved (Daugherty & Wicklein).

The Daugherty and Wicklein (1996) study sampled exemplary technology education teachers; the same ones sampled in Wicklein's 1993 study *Identifying Critical Issues and Problems in Technology Education Using a Modified Delphi Technique* and associated secondary education teachers of mathematics and science. The instrument used was a questionnaire piloted by the researchers (Daugherty & Wicklein).

Their study demonstrated a significant difference between the perceptions of the mathematics and science teachers and those of technology education teachers. The science and mathematics teacher groups perceptions of methodology within technology education were significantly lower than those teachers who taught technology education (Daugherty & Wicklein, 1993).

Daugherty and Wicklein (1993) concluded that this typifies the perception problem as external to the profession. This was also true of the perceptions of the curriculum content between the technology education faculty and the mathematics and science faculty. This implies that perceptions of strength in curricular content were not perceived to be as strong. Daugherty and Wicklein concluded that the discipline of technology education needs to define and change their image to improve the overall fields perception.

Rogers (1995) examined the technology education curriculum from the perspective of trade and industrial education. Rogers noted, "the curriculum of both technology education and trade and industrial education was in a state of stormy transition" (p. 59). Rogers pointed out that industrial arts education had clear articulation with trade and industrial education that technology education did not, but should. Rogers suggested that one approach would be to define technology education as pre-vocational. Rogers supported this approach by referring to the Perkins Act, several states' Department of Public Instruction, curricular guides, and the Jackson's Mill Industrial Arts Curriculum Theory (Rogers).

Schmeling (2003) conducted a study on school principals in the Milwaukee Public schools on their perceptions of technology education. This study used the CTES to determine the perceptions of the 80 principals and the vice principals of the Milwaukee Public Schools' high schools on each survey item. The majority of principals and vice principals indicated that all students should be able to take technology education courses. They also indicated that they still perceived technology education as being industrial arts.

Nine studies that directly focused on perception were found. Of those nine only one study asked the parents what they thought of their child's curriculum. Bonfadini's study was conducted in 1982 by the industrial arts community and also found that the parents were in full support of a curriculum that taught the use of common hand tools. The parents showed little support, at that time, for the then emerging technology education curriculum. Three of the studies involved the students who were taking the industrial arts–technology education courses.

Perceptions of leaders in the field of technology education were surveyed in 1999 by Karnes. He asked 35 leaders in the field of technology education to answer the question: "What are the most critical changes or improvements which must be made if technology education is to be an integral component of strategic importance in the total educational enterprise of the new century" (p. 11). In answering this question, 20 of the 35 respondents identified the area of marketing as being the area in most need of critical change.

Leaders also specifically mentioned three other items of critical change: (1) defining a vision for technology education and/or the technology education curriculum, (2) strategic positioning of technology education, and (3) the perception of various publics toward technology education (Karnes, 1999). This supported the idea of Daugherty, Hill, and Wicklein (1996) that there has been a growing realization for education to be marketed and sold like other products. The public has the power to determine whether or not the programs exist in the schools. For this reason Daugherty, Hill, and Wicklein thought it was important to study the way the public perceive technology education (1996).

2.9 Survey Validity & Reliability

The primary purpose of conducting a survey is to enable the researcher to examine some characteristic or trait as it relates to the people being surveyed and/or the phenomena about which the people are being asked (Fink, 1995). If the conclusions of the research are to have merit, the findings must be based on reliable scores obtained from valid surveys. As with any research study, dependable results are contingent upon the researcher's ability to collect valid and reliable data that provide an accurate estimation of the element that is being measured (Litwin, 1995). Otherwise stated, to be dependable, the survey instrument must measure what it was designed to measure and offer a reliable approximation of what is actually being measured (Linn & Miller, 2005).

Validity can be defined as "the degree to which a test measures what it claims, or purports, to be measuring" (Brown, 1996, p. 231). According to Mason and Bramble (1989) there are three general tests of validity. They are criterion-related validity, construct validity, and content validity.

Content validity measures how much of trait is being represented by the domain. To demonstrate content validity, researchers test a sample of objectives to see if they measure what it was designed to measure (Mason & Bramble, 1989). To examine the level of validity, researchers ask colleagues to review items and determine the level of agreement between items and design. This method provides the researcher a bank of items that measure the proper trait (Mason & Bramble, 1989).

Cronbach and Meehl (1955) indicated that, "Construct validity must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured" (p. 282). Construct is defined as a concept that is proposed to help clarify an aspect of human behavior, like intelligence (Van Dalen, 1979). When the researcher is trying to determine the underlying trait and must use indirect scores, that is when construct validity is used (Cronbach & Meehl, 1955).

Criterion-related validity focuses on determining if traits are represented in the criteria (Mason & Bramble, 1989). Criterion-related validity can be divided into two groups, concurrent validity and predictive validity. Predictive validity is how much agreement there is between the test it is designed to predict and the scores on the test. If the test and criterion scores are collected at the same time then the study is using concurrent validity (Cronbach & Meehl, 1955).

An established way to determine criterion-related validity is to give a survey to a group of people that you already know exhibit the trait you are researching (Cronbach & Meehl, 1955). Typically a panel of content area experts determines this group. Invaild items can be removed from the survey after the control group has taken the instrument. Items should be removed if they are inconsistent with the responses from the group. If the process is done well, only consistent items will remain (Cronbach & Meehl, 1955).

To determine the content validity for Daugherty, Hill, and Wicklein's (1996) study using the CTES, a pilot study was conducted. The CTES instrument was pilot tested to refine the survey items. The pilot study was also used to insure the survey's instructions were accurate. Participants at a professional workshop, provided written feedback about the survey to provide clarity and validity of the survey (Daugherty et al., 1996). 14 respondents participated in the pilot study. Based on the participant's feedback, two changes were made to survey questions. Neither construct validity, nor criterion-related validity tests were used to confirm validity of the CTES (Daugherty, Hill, & Wicklein, 1996).

Reliability refers to the extent to which a measure or score is repeatable and consistent and free from random errors (Litwin, 1995). Alwin (2007) expounded on the importance of reliability as it relates to measurement by observing, "reliability is not a sufficient condition for validity, but it is necessary, and without reliable measurement, there can be no hope of developing scientific knowledge" (p. 16).

There are several types of reliability analyses that can be conducted to estimate a reliability coefficient for a test or survey including *alternate-form, inter-observer, intra-observer, test-retest, and internal consistency reliability.* In this study, only one form was administered, therefore alternate-form reliability does not apply because, according to Crocker and Algina (1986), "the alternate form method requires constructing two *similar* forms of a test and administering both forms to the same group of examinees" (p.132). Inter-observer or *inter-rater* reliability is not relevant to the study either because the study does not examine the extent of agreement among two or more independent raters judging the same phenomena. Similarly, *intra*-observer reliability is not relevant to the study because it refers to the extent to which an individual observer is consistent in observational coding (Crocker & Algina, 1986).

Internal consistency estimates of reliability (ICR) are applied to groups of survey items (as opposed to single items) thought to measure different aspects of the same construct (Litwin, 1995). The CTES has four different groups of survey items, curriculum content, teaching methodology, integration, and fit of curriculum content, making it ideal to use ICR. Cronbach (1951) defined a survey with high internal consistency as one comprising of a positive correlation between two or more items. To measure ICR, Cronbach's Coefficient Alpha (α) is generally calculated as an index of a survey's internal consistency, which is determined by "the ratio of the sum of the item covariances to the total observed score variance" (Crocker & Algina, 1986, p. 153). Although there are other ways to measure ICR besides Cronbach's Coefficient Alpha (α), evidence suggest they all arrive at essentially the same estimates of reliability (Pedhazur & Pedhazur-Schmelkin, 1991).

According to Nunnally (1978), the higher the Coefficient Alpha is, the more reliable the test. Nunnally additionally noted that a Coefficient Alpha of 0.7 and above is acceptable level. For Daugherty, Hill, and Wicklein's (1996) study using the CTES, the Cronbach Coefficient Alpha (α) test was used to establish internal consistency and reliability for the survey. A reliability index of r = .90 for the pilot study was achieved. According to Cortina (1993) an alpha score greater than or equal to 0.9 is considered excellent internal consistency. This score would not change for the CTES as long as the survey itself does not change (Cortina, 1993).

2.10 Survey Item Design

Researchers have used surveys for many years and although many forms have been proposed and tested over the last century, the Likert (1932) scale is still by far the most widely used technique for scaling item response options (Lange & Soderlund, 2004). Rensis Likert originally proposed that his scale was a summated scale to be used to assess the attitudes of survey respondents. Although technically the term Likert scale refers to a summated score produced by a survey comprised of Likert-type items rather than to an individual item itself, the term Likert scale is commonly used today to refer to the universal fixed format approach to measuring attitudes.

The Likert scale format consists of an item prompt such as a statement about the attitude being measured followed by a limited or discrete set of responses designed to capture a respondent's personal opinion about (or attitude toward) the item prompt. Typically, the Likert scale has four to seven response options, each consisting of a single word or short phrase that differs by varying degrees ranging from one negative extreme to its polar opposite positive extreme (e.g. from *strongly disagree* to *strongly agree* or *not at all likely* to *highly likely*). From the range of options presented, respondents are generally instructed to choose only one to indicate their level or degree of agreement or disagreement with the statement presented (Likert, 1932).

Originally, Likert (1932) proposed a person or groups attitudes could be measured with relative ease by using a five-category scale including three signature elements: The first two were designed to measure the direction (e.g., positive vs. negative or *agree* vs. *disagree*) and strength (*strongly agree vs. strongly disagree*) of the attitude and the third element served as a neutral point (*neither agree nor disagree*) for respondents who could not (or would not) choose between the options presented. He also advocated the use of including *don't know* as a response option so researchers could make distinctions between people who had no opinion (or honestly did not know) and those who were genuinely neutral. While there is no consensus on the optimal number of response options to use, it is fair to say more researchers claim the ideal number is five (Lissitz & Green, 1975; Jenkins & Taber, 1977) or seven (Symonds, 1924; Grigg, 1980; Preston & Colman, 2000; Witteman & Renooij, 2002) than any other number; and most agree an odd number is best to allow for an "average" position on the scale (Grigg, 1980).

According to Dillman (2007), a number of guidelines beyond the scale selection are important in the development and design of effective survey items. Survey items that are ranked on the Likert scale should be concise. The items should be simply stated, use conversational language, and should be free of any spelling or grammatical errors (Dillman). Dillman indicated that items should very specific. He also argued that easy questions should be located at the start of the survey, while difficult items should be placed at the end of the survey instrument. This is done to encourage participation (Dillman).

Bradburn, Sudman, and Wansink (2004) discussed the issues of leading, loaded, and double-barrelled questions. Leading questions are items that imply a certain answer. Loaded questions are items that imply a hidden social meaning or provide an emotional response. Double-barreled questions are ones in which two issues at presented in one question. According to Bradburn, Sudman, and Wansink, all three of these types of question items should be avoided in any survey questionnaires as they will lead researchers to poor results.

2.11 Summary

The review of literature presented different viewpoints of many researchers within the field of ETE. The review showed factors which have contributed to the formation of perceptions of the field of ETE. The historical perspective from manual arts to ETE was discussed as a basis for perceptions of pre-engineering programs. The focus and benefits of pre-engineering education show why the engineering aspects were added to the technology education curriculum. The survey's validity, reliability, item scale and item designs were also discussed.

CHAPTER 3 METHODOLOGY

The purpose of this study was to determine ETE teachers' perceptions of PLTW's pre-engineering program in the state of Indiana by utilizing the Daugherty, Hill, and Wicklien's (1996) CTES survey. The purpose of this chapter was to describe the design of the study, its population, the data collection process utilized, and the data analysis that was used.

3.1 Design of Study

The data were collected using *www.surveymonkey.com*, a web-based survey program. Other past studies utilizing the CTES had been conducted using mailings through the United States Postal Service or other manual delivery services. Using this web-based design, the participants were contacted using school email accounts and invited to visit a web site which allowed them to answer questions on the survey instrument. The data were downloaded from the web site and then used for analysis.

In an earlier study by Daugherty, Hill, and Wicklein (1996) the CTES, a two-page (45 item) questionnaire, was utilized (see Appendix A). The survey was designed to determine an individual's perceptions of the characteristics of the field of technology education. This instrument was also used in a previous study that examined the perceptions of technology education teachers, administrators, and guidance counselors (Daugherty, & Wicklein, 1993).

The CTES questionnaire contained two sections. The first section requested demographic data including highest degree attained, years of teaching experience, type of school district setting, current grade levels taught, if they had been trained in any PLTW pre-engineering course, and the current courses that the educator was teaching. This study modified the type of school district data, according to Freeman (2010), to include the following: rural community (population <10,000), small town (population 10,000-19,999), suburban (population 20,000-49,999), and urban (population >50,000). Information regarding demographics was important for analysis of the respondents' perception as well as analysis of the descriptive statistical information (Daugherty et al., 1996).

Section II contained the remaining 40 items of the survey that were related to four areas: "curriculum content, methodology, integration of technology education with other school subjects, and fit within the total school environment" (Daugherty et al., 1996, p. 12). These interconnected categories were based on Savage and Sterry's (1*990) Conceptual Framework for Technology Education*. Items one through eight in Section II of the survey focused on the intent of the curriculum and understanding of the course content for technology education. Survey items 9 through 22 measured perceptions of the methodology used in ETE. Survey items 23 through 33 were used to determine how subject matter integration (chiefly mathematics and science) was perceived to occur within the ETE curriculum. Survey items 34 through 40 relayed perceptions ETE and its relationship to the total school environment (Daugherty et al., 1996).

Responses to the items on the CTES were marked on a five point Likert-type (1932) rating scale: (1) *strongly disagree,* (2) *disagree,* (3) *no opinion, (4) agree,* (5) *strongly agree.* This study used the same survey with a modification to each question reflecting the name change from technology Education to Engineering and Technology Education.

3.2 Population

The population included all the Indiana ETE teachers for grades 9 through 12 listed in a database file produced from IDOE website, *http://doe.in.gov/octe*. The survey instrument asked what grade level the teacher was instructing only to verify current grade level.

At the time of the study, 608 ETE teachers' email addresses were available (excluding this researcher). An email cover letter (see Appendix B) was sent to explain the purpose and scope of the study to each email address and provided the web site address, *http://wwwsurveymonkey.com* where the potential participants were to fill out the survey instrument.

No tests or experimental procedures were used in this study. With regards to protecting human subjects, a human subjects' exemption was received through the Committee on the Use of Human Research Subjects Office of Research Administration at Purdue University (see Appendix C). To protect each responding participant, the identity option was disabled within the survey accounts website. Consequently, each participant's identity remained anonymous. Consent was obtained when respondents participated (logged on) in the CTES.

3.3 Data Collection

The survey was distributed using *Dillman's Total Design Method* (TDM) schedule (Dillman, 2007). Individuals received four email contacts from the researcher via email, consistent with the traditional Dillman's TDM of four hard copy contacts. Using internet emails and a website as the data collection vehicle proved to be efficient, productive, and informative. Respondents to the survey instrument support the Poole and Loomis (2009) study which statistically supports internet survey method to be equal to the previously used paper and pencil survey.

3.4 Variables

The independent variables in the study were the respondents' educational level, number of years teaching, type of school district, predominate grade level being taught, and courses being taught. The dependent variables in the study were the perceptions of ETE teachers who were and those who were not teaching PLTW's pre-engineering program as it relates to the curriculum content, teaching methodology, integration, and fit of curriculum content.

3.5 Survey Results

The survey was uploaded to a website *www.surveymonkey.com* on March 30, 2011. Six hundred and eight emails were used for the distribution list. The survey was released to these participants on March 31, 2011. Fifty-three emails were immediately rejected by the website as invalid emails. Thus, a total of 555 surveys were distributed across the state of Indiana. Following Dillman's TDM, participants received three follow up emails over the next four weeks. Responses were collected until April 27, 2011. A total of 282 surveys were collected for analysis with a response rate of 51.3%. Fifty-three teachers reported they were teaching middle school classes (grades 6-8) as well as high school classes (grades 9-12).

The respondents were all identified as ETE teachers. Table 3.1 reflects the demographic data collected on the educational level of teachers. Of the 282 respondents, 64.9% had earned a Master's degree while 34.9% had only earned a Bachelor's degree. One respondent (0.2%) had earned a doctorate degree.

Table 3.1
Educational Level of Teacher (N=282)

Level	Freq.	Percent
Bachelor's	98	34.9
Master's	183	64.9
Doctorate	1	0.2
	282	100.0

Table 3.2 showed the demographic data collected on the years of teaching experience. Of the 282 respondents, teachers with five to nine years of experience had the highest frequency at 62 teachers or 22.0%. Teachers with zero to four years experience had the next highest frequency at 49 or 17.4%. Teachers with 10 to 14 and 20 to 24 years experience had the same frequency of 23 or 8.1%. While teachers with 30 to 34 and over 35 years of experience had the same frequency at 36 or 12.8%.

Table 3.2
Years of Teaching (N=282)

Years	Freq.	Percent
0-4	49	17.4
5-9	62	22.0
10-14	23	8.1
15-19	24	8.5
20-24	23	8.1
25-29	29	10.3
30-34	36	12.8
35+	36	12.8
	282	100.0

Table 3.3 showed the demographic data collected on the type of school district where the teachers work. Of the 282 respondents, rural teachers had the highest frequency with 34.8% (f = 98) responding. Suburban teachers had the next highest frequency with 30.8% (f = 87) responding. Urban teachers followed with a frequency of 22.3% (f = 63) and small town teachers had a frequency of 12.1% (f = 34) responding. The response was divided almost equally between populations with greater than or less than 20,000 residents. Urban and suburban teachers had 53.1% (f = 150) respond, while small town and rural community teachers had 46.9% (f = 132) respond.

Table 3.3
Type of School District (N=282)

Type	Freq.	Percent
Urban area (population >50,000)	63	22.3
Suburban area (population 20,000-49,999)	87	30.8
Small town (population 10,000-19,999)	34	12.1
Rural Community (population <10,000)	98	34.8
	282	100.0

Note. The type of school district is defined as according to Freeman (2010).

Table 3.4 showed the demographic data collected on whether the ETE teachers are or are not certified in a PLTW pre-engineering course. Of the 282 respondents 62.1% (f = 175) have been certified to teach at least one PLTW pre-engineering course.

Table 3.4
Certified in any PLTW Pre-engineering Courses (N=282)

Item	Freq.	Percent
Yes	175	62.1
No	107	37.9
	282	100.0

Table 3.5 reflects the demographic data collected on the ETE grade level currently being taught. Of the 282 respondents, 18.8% (f = 53) of teachers reported teaching grades six through eight. These teachers also reported teaching students in grades nine through twelve. The frequencies show that over 90% of all ETE teachers are teaching multiple grades at the high school level.

Table 3.5
Grade Level Currently Teaching (N=282)

Grade	Freq.	Percent
6 - 8	53	18.8
9	255	90.4
10	276	97.9
11	275	97.5
12	274	97.2

Table 3.6 showed the demographic data collected on the ETE courses currently being taught. The 282 respondents of the study taught 1276 classes, which averaged about 4.5 classes per teacher. The highest frequency at 42.2% (f = 119) was Introduction to Engineering Design which is a PLTW certified pre-engineering course. Of the other

PLTW courses, Principles of Engineering had the next highest frequency at 34.4% (f = 97). The lowest PLTW course frequency was Biotechnology Engineering at 1.8% (f = 5). In the non-PLTW ETE course, Construction Systems had the highest frequency at 37.2% (f = 105) of teachers. Manufacturing Systems had the next highest frequency at 34.8% (f = 98). The lowest non PLTW ETE course frequency at 2.5% (f = 7) was Technology & Society.

Table 3.6

Courses Teachers are Currently Teaching (N=1276)

Course	Freq.	Percent
Introduction to Engineering Design[a]	119	42.2
Construction Systems	105	37.2
Manufacturing Systems	98	34.8
Principles of Engineering[a]	97	34.4
Construction Processes	91	32.3
Manufacturing Processes	81	28.7
Design Processes	81	28.7
Transportation Systems	80	28.4
Communication Systems	74	26.2
Computers in Design and Production	66	23.4
Transportation Processes	57	20.2
Communication Processes	52	18.4
Civil Engineering & Architecture[a]	44	15.6
Introduction to Technology	42	14.9
Fundamentals of Engineering	37	13.1
Technology Systems	34	12.1
Digital Electronics[a]	34	12.1
Engineering Design and Development[a]	28	9.9
Technology Enterprise	17	6.0
Computer Integrated Manufacturing[a]	15	5.3
Aerospace Engineering[a]	12	4.3
Technology and Society	7	2.5
Biotechnology Engineering[a]	5	1.8

Note. [a] PLTW Pre-engineering Courses.

3.6 Data Analysis

Each item on the returned surveys (Section I and II) was analyzed using the SAS computerized statistical software available at Purdue University. Survey results furnished the basis for the testing of the four null hypotheses. The analysis of null hypotheses, (H_o1 through H_o4) was reported by computing the average response rate on the five-point Likert-type scale. This descriptive statistic was addressed by evaluating individual educator responses to questions one through forty of the 40 Likert-type scale items in Section II of the CTES. The responses were evaluated on a scale of assigned values of one through five, with one representing strongly disagree and five representing strongly agree. A value of three indicates neutrality or no opinion.

Analysis of Variance (ANOVA), was used to compare teachers who were and who were not certified in PLTW's pre-engineering courses related to curriculum content, teaching methodology, subject integration, and fit of curriculum. According to Howell (2002), ANOVA is used to test hypotheses about differences between two or more arithmetic means. Researchers can use a t-test when two or more means occur. However, conducting multiple t-tests can lead to an inflated Type I error rate. Researchers use ANOVA to test for the differences among means because it will not increase the Type I error rate (Howell, 2002).

After conducting ANOVA testing on the means of teacher's perceptions, a multi-variate analysis of variance or MANOVA was employed to assess differences in the mean scores among groups. According to Sahai and Ageel (2000), MANOVA is a method where variations associated with different factors or sources may be secluded and estimated. It is used when the analysis has two or more dependent variables. This study used MANOVA to test the interaction of the dependent variables (the perceptions of ETE teachers who were and those who were not teaching PLTW's pre-engineering program as it relates to the curriculum content, teaching methodology, integration, and fit of curriculum content) with the independent variables in the study (educational level earned, number of years teaching, type of school district, predominate grade level being taught, and courses being taught).

According to Foster (2009) it is common to use a probability value typically described as the p-value when testing for significance. The p-value ranges from 0.0 to 1.0, which represents how improbable a statistic would be, if the hypothesis being tested were true. The p-value was established at the $p \leq .05$ level of significance for the study (Foster).

3.7 Summary

Chapter Three described the design of the study, its population, the variables, and the data collection process. An email cover letter and a link to a website for the survey instrument were distributed. Survey data were collected from a website. The demographic data of the study was discussed. Data analysis techniques and null hypothesis were discussed. Chapter Four will present the data.

CHAPTER 4 DATA ANALYSIS

This chapter presents the results of the Characteristics of Technology Education Survey (CTES). The results were analyzed to determine the perceptions of Indiana's ETE teachers who were and who were not teaching PLTW's pre-engineering programs as it related to the curriculum content, teaching methodology, integration, and fit of curriculum content.

4.1 Mean Data

Table 4.1 provides the mean scores for each of the 40 items on the CTES for the ETE teachers in Indiana who participated in this study. The mean scores were calculated based on a Likert-type scale of one (strongly disagree) to five (strongly agree). Mean scores are presented in descending order. Survey question number 34, *ETE should be available to all students*, had the highest mean (M = 4.4, SD = 0.84). While question 18, *ETE modular education should be dominate* had the lowest mean (M = 2.7, SD = 1.08).

Identical calculations were completed for Table 4.2 and Table 4.3. The results in Table 4.2 showed the perceived characteristic of the ETE teachers who were not certified in a PLTW Pre-engineering course. Table 4.3 showed the results for perceived characteristic of all ETE teachers who were certified in a PLTW Pre-engineering course. For both tables, survey question number 34, *ETE should be available to all students*, had the highest mean (M = 4.5, SD = 0.84). Question 18, *In ETE modular curriculum should be dominant*, was the lowest mean (M=2.7, SD =1.08) for both Table 4.2 and 4.3.

Table 4.1
Perceived Characteristics of All ETE Teachers in Priority Order by Mean Ratings

Item #	Item Statement	Mean	SD
34	ETE should be available to all students	4.4	0.84
9	ETE places an emphasis on solving problems	4.4	0.73
26	ETE teachers connect science and mathematics content	4.3	0.68
39	ETE should be available for all students	4.3	0.99
25	Students apply other subjects in ETE	4.3	0.70
21	ETE instruction aids in development of student problem solving	4.3	0.78
24	ETE lessons should reinforce other schools subjects	4.3	0.78
27	ETE applies concepts of other subjects	4.3	0.66
12	ETE encourages cooperative learning	4.2	0.71
28	ETE leaders should encourage subject matter integration	4.2	0.77
7	ETE aids students to develop insights in the use of technology	4.2	0.83
10	ETE provides exploratory activities (modeling production)	4.2	0.75
8	ETE curriculum allows for use of tools, materials, & machines	4.1	0.96
23	ETE should emphasize interdisciplinary activities	4.1	0.77
22	ETE instruction aids in development of lifelong learning goals	4.1	0.90
11	ETE instruction is goal oriented	4.1	0.75
19	In ETE, lab activities reinforce abstract concepts	4.0	0.85
29	ETE is applied science	4.0	0.89
2	ETE conveys knowledge about technological developments	4.0	0.69
30	ETE reflects content of business and industry	4.0	0.82
20	ETE instruction aids in development of creativity and self-image	4.0	0.95
16	In ETE, students are encouraged to discuss concepts and issues	4.0	0.78
15	In ETE, a broad range of assessment strategies are used	3.9	0.80
5	ETE has a portion of content based on modifying materials	3.9	0.86
38	ETE should develop strategies for overcoming stereotypes	3.9	0.89
33	ETE programs should reflect interdisciplinary concepts	3.9	0.84
1	ETE has an organized set of concepts, processes, and systems	3.9	0.80
37	Research should be conducted on the integration needs in ETE	3.9	0.80
6	ETE has content based on the study of transportation	3.9	0.84
13	ETE encourages oral presentations	3.8	0.95
4	ETE has a portion of content based on information transfer	3.8	0.71
31	ETE is guided by technological literacy needs	3.8	0.93
14	In ETE cognitive strategies are clearly developed	3.7	0.96
17	In ETE students are encouraged to learn about underlying issues	3.7	0.89
32	ETE teachers should form interdisciplinary committees	3.6	0.90
40	ETE should focus on the college-prep needs of students	3.5	1.11
3	ETE has a portion of content based on a biological organizer	3.1	0.65
35	ETE should be focused on the needs of special ed. students	3.0	1.12
36	ETE should focus on the non-college bound student	3.0	1.23
18	In ETE modular curriculum should be dominant	2.7	1.08

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.2
Perceived Characteristics of All ETE Teachers who are Not Certified in a PLTW Pre-engineering Course in Priority Order by Mean Ratings

Item #	Item Statement	Mean	SD
34	ETE should be available to all students	4.5	0.84
9	ETE places an emphasis on solving problems	4.4	0.71
21	ETE instruction aids in development of student problem solving	4.4	0.70
25	Students apply other subjects in ETE	4.4	0.58
26	ETE teachers connect science and mathematics content	4.3	0.61
24	ETE lessons should reinforce other schools subjects	4.3	0.69
39	ETE should be available for all students	4.3	1.07
27	ETE applies concepts of other subjects	4.3	0.57
22	ETE instruction aids in development of lifelong learning goals	4.2	0.82
28	ETE leaders should encourage subject matter integration	4.2	0.75
23	ETE should emphasize interdisciplinary activities	4.1	0.74
12	ETE encourages cooperative learning	4.1	0.70
7	ETE aids students to develop insights in the use of technology	4.1	1.00
10	ETE provides exploratory activities (modeling production)	4.1	0.88
8	ETE curriculum allows for use of tools, materials, & machines	4.1	1.13
11	ETE instruction is goal oriented	4.0	0.85
29	ETE is applied science	4.0	0.90
30	ETE reflects content of business and industry	4.0	0.81
19	In ETE, lab activities reinforce abstract concepts	4.0	0.82
20	ETE instruction aids in development of creativity and self-image	4.0	1.03
2	ETE conveys knowledge about technological developments	4.0	0.79
38	ETE should develop strategies for overcoming stereotypes	4.0	0.84
37	Research should be conducted on the integration needs in ETE	3.9	0.89
15	In ETE, a broad range of assessment strategies are used	3.9	0.86
16	In ETE, students are encouraged to discuss concepts and issues	3.9	0.87
33	ETE programs should reflect interdisciplinary concepts	3.9	0.88
5	ETE has a portion of content based on modifying materials	3.9	0.94
1	ETE has an organized set of concepts, processes, and systems	3.9	0.80
6	ETE has content based on the study of transportation	3.8	0.92
4	ETE has a portion of content based on information transfer	3.8	0.71
31	ETE is guided by technological literacy needs	3.8	0.99
13	ETE encourages oral presentations	3.8	0.95
14	In ETE cognitive strategies are clearly developed	3.7	0.96
17	In ETE students are encouraged to learn about underlying issues	3.7	0.89
32	ETE teachers should form interdisciplinary committees	3.6	0.90
40	ETE should focus on the college-prep needs of students	3.5	1.11
3	ETE has a portion of content based on a biological organizer	3.1	0.65
35	ETE should be focused on the needs of special ed. students	3.0	1.12
36	ETE should focus on the non-college bound student	3.0	1.23
18	In ETE modular curriculum should be dominant	2.7	1.08

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.3
Perceived Characteristics of Only ETE Teachers who are Certified in a PLTW Pre-engineering Course in Priority Order by Mean Ratings

Item #	Item Statement	Mean	SD
34	ETE should be available to all students	4.4	0.85
9	ETE places an emphasis on solving problems	4.4	0.75
39	ETE should be available for all students	4.4	0.94
26	ETE teachers connect science and mathematics content	4.3	0.72
25	Students apply other subjects in ETE	4.3	0.77
12	ETE encourages cooperative learning	4.3	0.71
21	ETE instruction aids in development of student problem solving	4.3	0.83
10	ETE provides exploratory activities (modeling production)	4.3	0.66
7	ETE aids students to develop insights in the use of technology	4.3	0.71
27	ETE applies concepts of other subjects	4.3	0.70
24	ETE lessons should reinforce other schools subjects	4.2	0.82
8	ETE curriculum allows for use of tools, materials, & machines	4.2	0.83
28	ETE leaders should encourage subject matter integration	4.2	0.78
23	ETE should emphasize interdisciplinary activities	4.1	0.80
11	ETE instruction is goal oriented	4.1	0.68
22	ETE instruction aids in development of lifelong learning goals	4.1	0.94
19	In ETE, lab activities reinforce abstract concepts	4.1	0.87
2	ETE conveys knowledge about technological developments	4.1	0.62
29	ETE is applied science	4.0	0.89
16	In ETE, students are encouraged to discuss concepts and issues	4.0	0.71
30	ETE reflects content of business and industry	4.0	0.83
20	ETE instruction aids in development of creativity and self-image	4.0	0.90
5	ETE has a portion of content based on modifying materials	4.0	0.81
15	In ETE, a broad range of assessment strategies are used	3.9	0.77
1	ETE has an organized set of concepts, processes, and systems	3.9	0.72
33	ETE programs should reflect interdisciplinary concepts	3.9	0.81
38	ETE should develop strategies for overcoming stereotypes	3.9	0.92
6	ETE has content based on the study of transportation	3.9	0.79
37	Research should be conducted on the integration needs in ETE	3.9	0.89
31	ETE is guided by technological literacy needs	3.8	0.93
13	ETE encourages oral presentations	3.8	0.95
4	ETE has a portion of content based on information transfer	3.8	0.71
14	In ETE cognitive strategies are clearly developed	3.7	0.96
17	In ETE students are encouraged to learn about underlying issues	3.7	0.89
32	ETE teachers should form interdisciplinary committees	3.6	0.90
40	ETE should focus on the college-prep needs of students	3.5	1.11
3	ETE has a portion of content based on a biological organizer	3.1	0.65
35	ETE should be focused on the needs of special ed. students	3.0	1.12
36	ETE should focus on the non-college bound student	3.0	1.23
18	In ETE modular curriculum should be dominant	2.7	1.08

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

4.2 Survey Reliability

For this study using the CTES, the Cronbach Coefficient Alpha (α) test was used to establish reliability and internal consistency for the questionnaire. Items one through forty were used to calculate the Coefficient Alpha and resulted in a reliability index of r = .74 for the study.

4.3 Null Hypothesis One

H_o1: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES with regards to curriculum content.

Table 4.4 provides the mean scores for items one through eight concerned with curriculum content. The table presents the means for teachers who were and teachers who were not certified in PLTW's pre-engineering program. Both groups had survey item number seven, *ETE aids students to develop insights in the use and application of technology* with the highest mean.

Table 4.5 exhibits a one-way ANOVA comparing teachers' perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with curriculum content. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to curriculum content at the level $p < 0.05$ [$F = 0.20$, $p = 0.653$]. Therefore, null hypothesis one (H_o1) was retained for curriculum content.

Table 4.4
Perceived Characteristics of Curriculum Content

Item #	Item Statement	PLTW Mean	PLTW SD	Non- PLTW Mean	Non- PLTW SD
1	ETE has an organized set of concepts, processes, and systems	3.9	0.72	3.8	0.92
2	ETE conveys knowledge about technological developments	4.0	0.62	4.0	0.79
3	ETE has a portion of content based on a biological organizer	3.1	0.62	3.1	0.70
4	ETE has a portion of content based on information transfer	3.8	0.82	3.8	0.71
5	ETE has a portion of content based on modifying materials	4.0	0.81	3.9	0.94
6	ETE has a portion of content based on the study of transport.	3.9	0.79	3.8	0.92
7	ETE aids students to develop insights in the use and application of technology.	4.3	0.71	4.1	1.00
8	The ETE curriculum allows for application of tools, materials, and machines	4.2	0.83	4.1	1.13

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.5
Summary of ANOVA Comparing PLTW with Curriculum Content

Source	Sum of Squares	df	Mean Square	F	P
PLTW	4.08	1	4.08	0.20	0.653
Error	5661.05	280	20.22		
Total	5665.19	281			

**Significant at $p < 0.05$

Further analysis was conducted on curriculum content to explore the different responses based upon educational level earned, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups. Table 4.6 showed a summary of a MANOVA that was conducted. All items failed to meet the significance criteria of $p<0.05$.

Table 4.6
Summary of MANOVA on Curriculum Content

Source	Sum of Squares	df	Mean Square	F	P
Education	79.81	2	39.90	1.96	0.143
Years	61.54	7	8.79	0.43	0.881
District Type	88.75	3	29.58	1.45	0.228
Grade	73.38	7	10.48	0.51	0.823
PLTW	75.59	1	75.59	3.71	0.055
Ed. * Grade	63.88	2	31.94	1.57	0.210
Grade*PLTW	73.28	3	24.43	1.20	0.311

**Significant at $p < 0.05$

4.4 Null Hypothesis Two

H_o2: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES with regards to the teaching methodology.

Table 4.7 provides the mean scores for CTES items nine through 22 that reflected teaching methodology. The table illustrates the mean for teachers who were and teachers who were not certified in PLTW's pre-engineering program. Both groups had survey item number nine, *ETE places an emphasis on solving problems* with the highest mean.

Table 4.8 is a one-way ANOVA comparing teachers who were and who were not teaching PLTW's pre-engineering curriculum with teaching methodology. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to teaching methodology at the level $p < 0.05$ [$F = 0.32$, $p = 0.570$]. Therefore, null hypothesis two (H_o2) was retained for teaching methodology.

Table 4.7
Perceived Characteristics of Teaching Methodology

Item #	Item Statement	PLTW Mean	PLTW SD	Non-PLTW Mean	Non-PLTW SD
9	ETE places an emphasis on solving problems	4.4	0.75	4.4	0.71
10	ETE provides exploratory activities (modeling production)	4.3	0.66	4.1	0.88
11	ETE instruction is goal oriented	4.1	0.68	4.0	0.85
12	ETE encourages cooperative learning	4.3	0.71	4.1	0.70
13	ETE encourages oral presentations	3.9	0.91	3.7	1.01
14	In ETE cognitive strategies are clearly developed	3.8	0.90	3.6	1.04
15	In ETE a broad range of assessment strategies are used	3.9	0.77	3.9	0.86
16	In ETE, students are encouraged to discuss concepts and issues	4.0	0.71	3.9	0.87
17	In ETE, students are encouraged to learn about underlying issues	3.7	0.84	3.6	0.97
18	In ETE, modular curriculum should be dominant	2.8	1.07	2.6	1.09
19	In ETE, lab activities reinforce abstract concepts	4.1	0.87	4.0	0.82
20	ETE instruction aids in development of creativity and self-image	4.0	0.90	4.0	1.03
21	ETE instruction aids in development of student problem solving	4.3	0.83	4.4	0.70
22	ETE instruction aids in development of lifelong learning goals	4.1	0.94	4.2	0.82

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.8
Summary of ANOVA Comparing PLTW with Teaching Methodology

Source	Sum of Squares	df	Mean Square	F	P
PLTW	20.345	1	20.345	0.32	0.570
Error	17632.069	280	62.971		
Total	17652.414	281			

**Significant at $p < 0.05$

Further analysis was conducted on teaching methodology to explore the different responses based upon educational level earned, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups. Table 4.9 showed a summary of a MANOVA that was conducted. All items failed to meet the significance criteria of $p<0.05$.

Table 4.9
Summary of MANOVA on Teaching Methodology

Source	Sum of Squares	df	Mean Square	F	P
Education	237.36	2	118.68	1.88	0.155
Years	297.07	7	42.44	0.67	0.696
District Type	280.52	3	93.51	1.48	0.221
Grade	243.21	7	34.75	0.55	0.796
PLTW	168.81	1	168.81	2.67	0.103
Ed. * Grade	240.02	2	120.01	1.90	0.152
Grade*PLTW	243.44	3	81.15	1.28	0.280

**Significant at $p < 0.05$

4.5 Null Hypothesis Three

H_o3: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as measured by the CTES with regards to the integration with other school subjects.

Table 4.10 provides the mean scores for items 23 through 33 that reflect integration with other school subjects. The table reflects the mean in teachers' responses who were and teachers who were not certified in PLTW's pre-engineering program. Both groups had survey item number 25 *students apply other subjects in ETE* with the highest means.

Table 4.11 is a one-way ANOVA comparing teachers who were and who were not teaching PLTW's pre-engineering curriculum with integration with other school subjects. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to integration with other school subjects at the level $p < 0.05$ [$F = 0.20$, $p = 0.655$]. Therefore, null hypothesis three (H_o3) was retained for integration with other subjects.

Table 4.10

Perceived Characteristics of Integration with Other Subjects

Item #	Item Statement	PLTW Mean	PLTW SD	Non-PLTW Mean	Non-PLTW SD
23	ETE should emphasize interdisciplinary activities	4.1	0.80	4.1	0.74
24	ETE lessons should reinforce other schools subjects	4.2	0.82	4.3	0.69
25	Students apply other subjects in ETE	4.3	0.77	4.6	0.58
26	ETE teachers connect science and mathematics content	4.3	0.72	4.3	0.61
27	ETE applies concepts of other subjects	4.3	0.70	4.3	0.57
28	ETE leaders should encourage subject matter integration	4.2	0.78	4.2	0.75
29	ETE is applied science	4.0	0.89	4.0	0.90
30	ETE reflects content of business and industry	4.0	0.83	4.0	0.81
31	ETE is guided by technological literacy needs	3.8	0.93	3.8	0.99
32	ETE teachers should form interdisciplinary committees	3.6	0.91	3.5	0.96
33	ETE programs should reflect interdisciplinary concepts	3.9	0.81	3.9	0.88

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.11

Summary of ANOVA Comparing PLTW with Other Subject Integration

Source	Sum of Squares	df	Mean Square	F	P
PLTW	6.25	1	6.25	0.20	0.655
Error	8738.97	280	31.21		
Total	8745.22	281			

**Significant at $p < 0.05$

Further analysis was conducted on the integration of ETE with other subjects to explore the different responses based upon educational level earned, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups. Table 4.12 showed a summary of a MANOVA that was conducted. All items failed to meet the significance criteria of $p<0.05$.

Table 4.12
Summary of MANOVA on Subject Integration

Source	Sum of Squares	df	Mean Square	F	P
Education	109.42	2	54.71	1.77	0.172
Years	286.26	7	40.89	1.33	0.238
District Type	198.27	3	66.09	2.14	0.095
Grade	165.49	7	23.64	0.77	0.616
PLTW	6.33	1	6.33	0.21	0.651
Ed. * Grade	15.16	2	7.58	0.25	0.782
Grade*PLTW	40.17	3	13.38	0.43	0.729

**Significant at $p < 0.05$

4.6 Null Hypothesis Four

H_o4: There is no significant difference between the perceptions of ETE teachers who were and who were not teaching PLTW’s pre-engineering program as measured by the CTES with regards to the "fit" within the total school environment.

Table 4.13 provides the mean scores for items 34 through 40 that reflect the "fit" within the total school environment. The table reflects the mean for teachers who were and teachers who were not certified in PLTW’s pre-engineering program. Both groups had survey item numbers 34 and 39 (which were the same question), *ETE should be available to all students* with the highest means.

Table 4.14 is a one-way ANOVA comparing teachers who were and who were not teaching PLTW’s pre-engineering curriculum with regards to the "fit" within the total school environment. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW’s pre-engineering curriculum with regards to the "fit" within the total school environment at the level $p < 0.05$ [$F = 0.28$, $p = 0.594$]. Therefore, null hypothesis four (H_o4) was retained for integration with other school subjects.

Table 4.13

Perceived Characteristics of Fit within School Environment

Item #	Item Statement	PLTW Mean	PLTW SD	Non- PLTW Mean	Non- PLTW SD
34	ETE should be available to all students	4.4	0.85	4.5	0.84
35	ETE should be focused on the needs of special education students	2.9	1.08	3.0	1.19
36	ETE should focus on the non-college bound students	2.8	1.20	3.3	1.22
37	Research should be conducted on the integration needs in ETE	3.8	0.74	3.9	0.89
38	ETE should develop strategies for overcoming stereotypes	3.9	0.92	4.0	0.84
39	ETE should be available for all students	4.4	0.94	4.2	1.07
40	ETE should focus on the college-prep needs of students	3.5	1.10	3.4	1.12

Note. Mean score based upon five point scale: (1) *strongly disagree* to (5) *strongly agree.*

Table 4.14

Summary of ANOVA Comparing PLTW with the Fit within the School Environment

Source	Sum of Squares	df	Mean Square	F	P
PLTW	4.84	1	4.84	0.28	0.594
Error	4760.25	280	17.00		
Total	4765.09	281			

**Significant at $p < 0.05$

Further analysis was conducted with regards to the "fit" within the school environment to explore the different responses based upon educational level earned, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups. Table 4.15 showed a summary of a MANOVA that was conducted. All items failed to meet the significance criteria of $p<0.05$.

Table 4.15
Summary of MANOVA on the Fit within School Environment

Source	Sum of Squares	df	Mean Square	F	P
Education	101.29	2	50.61	2.95	0.054
Years	45.36	7	6.48	0.38	0.915
District Type	61.16	3	20.39	1.19	0.315
Grade	42.65	7	6.09	0.35	0.928
PLTW	1.97	1	1.97	0.11	0.735
Ed. * Grade	3.46	2	1.73	0.10	0.904
Grade*PLTW	33.33	3	11.11	0.65	0.586

**Significant at $p < 0.05$

4.7 Summary

Chapter 4 presented the results of the Characteristics of Technology Education survey. The results were analyzed to determine the perceptions of Indiana's ETE teachers who were and those who were not teaching PLTW's pre-engineering program as it relates to the curriculum content, teaching methodology, integration, and fit of curriculum content. All four null hypotheses were retained as they failed to meet the significance criteria of $p < 0.05$.

Further MANVOA was conducted with regards to the curriculum content, teaching methodology, integration, and fit of curriculum content to explore the different responses based upon educational level earned, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups. No significant differences were found.

CHAPTER 5 DISCUSSION

This chapter includes an overview of the study, the major findings of the study, and a discussion relative to the findings. Conclusions and questions drawn from the findings and recommendations are presented.

5.1 General Overview

The purpose of this study was to determine ETE teachers' perceptions of PLTW's pre-engineering program in the state of Indiana by utilizing Daugherty, Hill, and Wicklein's (1996) Characteristics of Technology Education Survey (CTES). This study examined the teachers who were and who were not teaching PLTW's pre-engineering perceptions on the basis of curriculum content, teaching methodology, program integration, and course fit.

This study answered the following four questions which were based on a study conducted by Daugherty, Hill, and Wicklein (1996):

1. Is there a significant difference in the perception of the ETE curriculum content between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?
2. Is there a significant difference in the perception of ETE teaching methodology between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?

3. Is there a significant difference in the perception of the integration of ETE with other school subjects between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?
4. Is there a significant difference in the perception of the "fit" of ETE within the total school environment between Indiana PLTW teachers and non-PLTW teachers as measured by the CTES?

The Characteristics of Technology Education Survey, a 46 item online questionnaire was used to gather data and summarized in order to retain or reject the hypothesis. Two hundred and eighty two surveys were returned for a response rate of 51.3%. Results furnished the basis for the testing of the four hypotheses. A one-way ANOVA was used to test four hypotheses. The p-value was established at the $p < 0.05$ level of significance for this study.

5.2 Major Findings

Survey responses were employed to determine if there was a significant difference between the perceptions of ETE teachers who were and those who were not teaching PLTW's pre-engineering program (dependent variable) as their perceptions related to the curriculum content, teaching methodology, integration, and fit of curriculum content (independent variable). Synthesis of the results in Chapter 4 yielded the following major findings:

1. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to curriculum content at the level $p < 0.05$ [$F = 0.20$, $p = 0.653$].

2. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to teaching methodology at the level $p < 0.05$ [$F = 0.32$, $p = 0.570$].
3. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to integration with other school subjects at the level $p < 0.05$ [$F = 0.20$, $p = 0.655$].
4. There was no significant difference when comparing the perceptions of who were and who were not teaching PLTW's pre-engineering curriculum with regards to the "fit" within the total school environment at the level $p < 0.05$ [$F = 0.28$, $p = 0.594$].
5. No significant differences were found when MANVOA treatments were conducted with regards to the curriculum content, teaching methodology, integration, and fit of curriculum content to explore the different responses based upon educational level, number of years teaching, type of school district, the grade level being taught, the courses being taught, and the interaction between the groups.

5.3 Discussion

This study revealed the split in ideology that Zuga (1997) discussed historically, was not present with this study's participants. The 1917 Smith-Hughes Vocational Act defined a split in ideology within the industrial education groups, the paths for general education (industrial arts, now ETE) and career training (vocational arts, now CTE).

However, the findings in this study show a general agreement of these ETE teachers' vision of ETE.

The findings also support the general findings of Daugherty, Hill, and Wicklein (1996). General agreement was found between groups of teachers on both statements and the four categories (Daugherty et al.). As was the case in this study, there was general agreement among the teachers who were and the teachers who were not teaching PLTW pre-engineering curriculum.

According to PLTW (2009), the focus of pre-engineering is to increase the student engagement and enrollment in collegiate engineering programs by providing high school students with engaging curriculum. PLTW (2012) had zero pre-engineering programs in the state of Indiana in 1997 and in 2012 the number of PLTW programs in Indiana had grown to 635 programs. With this massive growth in PLTW programs, the results of this research indicated that Indiana ETE teachers have embraced an engineering focus in their curriculum which concurred with Rogers (2005). While not all teachers are teaching PLTW pre-engineering courses, the perceptions of these teachers did show a consensus in regards to curriculum content, by retaining Null Hypotheses One. In essence, ETE teachers who were and who were not teaching PLTW's pre-engineering courses, were all teaching with a focus on engineering curriculum content.

According to Pearson, (2004) the adoption of the *Standards for Technological Literacy (STL): Content for the Study of Technology* (ITEA) in 2000 has played a role in the general agreement among all ETE teachers. The participants in this study were in general agreement concerning curriculum content, teaching methodology, subject matter integration, and fit of curriculum content. The STL's placed emphasis on design, interrelationships with society, and the nature of technology (ITEA, 2000). According to Blais (2004) and Pearson (2004), the goals of technological literacy fit well in PLTW pre-engineering courses, as well as, all non-PLTW ETE courses. Students will gain technological literacy from all ETE teachers whether they were in a PLTW pre-engineering course or not.

This study found general agreement among the teachers who were and the teachers who were not teaching PLTW pre-engineering curriculum. The researcher has to wonder if this study had been conducted during the early 1970s comparing teachers who were and who were not teaching the Industrial Arts Curriculum Project (IACP), if the results would have been similar. In the late 1960s there were more than 30 different curriculum projects being attempted to innovate and improve industrial arts in schools. Eventually IACP became the standard of the time. Teachers presented industrial arts curriculum through IACP's two courses the *World of Construction* and the *World of Manufacturing* (Cochran, 1970).

Recent choices of pre-engineering curriculums in a high school were *Engineering by Design* (ITEEA, 2009), Ford's *Partnership for Advanced Studies* (2009), and Project Lead The Way's (PLTW) *Pre-engineering Curriculum* (2009). Eventually PLTW became the standard of the time. Today teachers present pre-engineering curriculum through PLTW's eight engineering courses, *Introduction to Engineering Design, Principles of Engineering, Digital Electronics, Computer Integrated Manufacturing, Civil Engineering & Architecture, Aerospace Engineering, & Engineering Design and Development* (PLTW,2009)

In both the IACP and current PLTW programs, teachers were given curriculum and support materials, received training, and underwent curriculum revisions. However even after all of the support, this study showed no differences of perceptions between ETE teachers who were and who were not teaching PLTW. In PLTW's case, changing curriculum does not change the perceptions of curriculum content, teacher methodology, integration, or subject fit. Would the IACP showed anything different?

This study also revealed some flaws in the design of the CTES. According to Bradburn, Sudman, and Wansink (2004), leading, loaded, and double-barrelled questions should be avoided in survey questionnaires. Follow up analysis revealed that survey item numbers 11, 21, 22, and 24 were leading questions and survey items number one, eight, 16, 20, and 26 were double-barrelled questions. In addition to the above flaws, the CTES was developed without conducting any construct validity or criterion-related validity tests to confirm validity (Daugherty, Hill, & Wicklein, 1996).

5.4 Conclusions

Within the boundaries of the limitations and assumptions of this study and with the limits that the data and findings were reliable and valid, the following conclusions have been drawn:

1. PLTW (2012) had zero pre-engineering programs in the state of Indiana in 1997. In 2012 PLTW had 635 programs in the state. With this massive growth in PLTW programs, ETE teachers in Indiana have embraced and adopted engineering into their curriculums.

2. By retaining Null Hypotheses One through Four, ETE teachers who are certified in PLTW pre-engineering courses show no differences in perceptions than those ETE teachers who are not certified in PLTW courses in the areas of curriculum content, teaching methodology, subject matter integration, and fit of curriculum.

5.5 Recommendations

According to the findings of this study (retaining all four null hypotheses), PLTW's attempts to differentiate itself from general ETE classes have failed to change the perceptions of Indiana's ETE teachers in regards to curriculum content, teaching methodology, subject matter integration, and fit of curriculum. It is recommended that PLTW redevelop an action plan to target why teachers are having misperceptions about PLTW's curriculum content, teaching methodology, subject matter integration, and fit of curriculum. Promotional material and teacher training should refocus the emphasis on engineering and the differences between its curriculum and the curriculum of ETE courses.

This study's findings show there is no difference in the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering regarding curriculum content. But ETE teachers are embracing engineering into their schools curriculum. PLTW has grown from zero programs in the state of Indiana in 1997, to 635 programs in 2012 (PLTW, 2012). To investigate further the level of acceptance of engineering into the ETE curriculum content, it is recommended that additional research be conducted to find out this level or depth of focus.

It would also be recommended that a further study of teachers who are and who are not teaching PLTW's pre-engineering be conducted. This study showed there was no difference in teacher's perceptions regarding curriculum content, teaching methodology, subject matter integration, and fit of curriculum. However that does not mean there are not differences among the two groups. Further studies of the two groups could look at how well teachers are preparing students to use the *Standards for Technological Literacy* (ITEA, 2000). Still another study could conduct a qualitative study of teachers and their views or perceptions on what makes PLTW pre-engineering different than general ETE courses.

In any future studies looking at ETE perceptions, a new survey instrument should be developed. It is clear to the researcher that the CTES was flawed in its original design. The CTES instrument has leading and doubled barreled questions that could allow the null hypotheses to be retained in any study conducted with this instrument. Any further investigation will first need to start with extensive work in developing a viable instrument that can provide reliable data.

A comparative study of IACP and PLTW would be recommended. There are some definite similarities including: industry based curriculum, teacher training, instructional textbooks, laboratory manuals, workbooks, curriculum maps, instructional guides, and standardized tests. In comparing the outcomes of IACP and PLTW, it might be helpful to find areas of improvement for PLTW based upon successes and failures of IACP.

5.6 Questions for Further Research

With the review of related literature, findings, conclusions, and recommendations the following questions for further research are offered in regard to this study:

1. What will the next survey instrument to collect data on ETE's teacher's perceptions look like? Based on this study, it is apparent that the CTES is flawed and should not be used in any further research. Future researchers will need to develop a new instrument to measure ETE perceptions.
2. Are PLTW's pre-engineering curriculum's different than Indiana's adopted ETE curriculums? Based on the analysis of data and the retention of the null hypotheses one through four; what are the differences in curriculum being taught between PLTW teachers and non-PLTW teachers? Further research needs to be conducted to determine what differences if/any are occurring. Also, it may be beneficial to look at student outcomes or course standards to determine if there are any differences between an ETE classroom and a PLTW pre-engineering classroom.
3. Has ETE embraced engineering as its core focus? In 2006, Wicklien argued that ETE should embrace engineering as the focus to help teach the *Standards for Technological Literacy* (ITEA, 2000). By retaining Null Hypothesis One, this study does show a consensus of curriculum content. Further research should be conducted as to what exactly is the focus for ETE.
4. What is the long rang outcome of PLTW? *The Industrial Arts Curriculum Project* was similar in nature to PLTW, yet it did not last forever. Further

research into avoiding potential decline like IACP would be recommended or explore the next step going forward beyond PLTW.

5. How long until the climate between ETE colleagues is not positive? With over 635 (IDOE, 2012) schools teaching PLTW's pre-engineering programs, one has to start wondering if non-PLTW teachers are feeling left out of the discussion? Further research should be conducted to determine whether these non-PLTW teachers still feel included in state ETE curriculum discussions. Will the perceptions of similarities between the two groups continue?
6. Does the location of this study matter? While this study was only conducted in the state of Indiana and its results may only be generalizable to Indiana high school ETE teachers, it would be a recommendation to conduct further studies involving more teachers in more states. Is the state of Indiana an exception to the norm or representative of ETE teachers across the nation?

5.7 Summary

The purpose of this study was to determine Engineering/Technology Education (ETE) teachers' perceptions of Project Lead The Way's (PLTW) pre-engineering program in the state of Indiana utilizing Daugherty, Hill, and Wicklein's 1996 Characteristics of Technology Education Survey (CTES). The study focused on the perceptions of teachers who were and who were not teaching PLTW's pre-engineering curriculum as they related to curriculum content, teaching methodology, curriculum integration, and fit of curriculum in school environment.

After surveying 282 Indiana high school ETE teachers and collecting and analyzing the responses to the 46 question CTES, the study found no significant differences in the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering program as they related to curriculum content, teaching methodology, curriculum integration, and fit of curriculum in school environment. . Null Hypotheses One through Four were retained.

This study's findings show there is no difference in the perceptions of ETE teachers who were and who were not teaching PLTW's pre-engineering regarding curriculum content. ETE teachers in the state of Indiana are embracing engineering into their schools curriculum. It is recommended that additional research be conducted to find to investigate further the level of acceptance of engineering into the ETE curriculum content. It is also recommended that further studies of ETE who are and who are not teaching PLTW pre-engineering curriculum be conducted with a newly developed survey instrument.

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APPENDICES

Appendix A

Characteristics of Technology Education Survey

SECTION I

The following section is used to determine the demographics of the sample and will be considered confidential.

What is your highest degree earned?
__Bachelor's __Master's __Ph.D.

How many years have you been teaching engineering/technology education?
__ 0-4
__ 5-9
__ 10-14
__ 15-19
__ 20-24
__ 25-29
__ 30-34
__ more than 35

In what type of school district do you teach?
__Urban area (pop 50,000 +) __Suburban area (20,000-49,999)
__ Small town (10,000-19,999) __Rural Community (pop<10,000)

What grade level(s) to you currently teach? (check all that apply)
__6^{th}- 8th
__9th
__10th
__11th
__12th

What do you teach? (check all that apply)
__ Introduction to Technology
__ Communication Systems
__ Construction Systems
__ Manufacturing Systems
__ Transportation Systems
__ Technology Systems
__ Computers in Design and Production Systems
__ Technology and Society
__ Technology Enterprise
__ Communication Processes

__ Manufacturing Processes
__ Transportation Processes
__ Construction Processes
__ Design Processes
__ Fundamentals of Engineering
__ Computer Integrated Manufacturing (PLTW)
__ Introduction to Engineering Design (PLTW)
__ Principles of Engineering (PLTW)
__ Civil Engineering and Architecture (PLTW)
__ Biotechnology (PLTW)
__ Aerospace (PLTW)
__ Digital Electronics (PLTW)
__ Engineering Design and Development (PLTW)

Are you certified in any PLTW pre-engineering courses?
___Yes ___ No

SECTION II

Directions: Please, respond to the following questions by clicking the Appropriate number, (1) strongly disagree, (2) disagree, (3) no opinion, (4) agree, (5) strongly agree. (Note: engineering/technology education is abbreviated as ETE)

1. ETE has an organized set of concepts, processes, and systems
2. ETE conveys knowledge about technological developments
3. ETE has a portion of content based on a biological organizer
4. ETE has a portion of content based on information transfer
5. ETE has a portion of content is based on modifying materials
6. ETE has a portion content based on the study of transportation
7. ETE aids students to develop insights in the use and application of technology
8. The ETE curriculum allows for application of tools, materials, and machines
9. ETE places an emphasis on solving problems
10. ETE provides exploratory activities (modeling production)
11. ETE is instruction is goal-oriented
12. ETE encourages cooperative learning
13. ETE encourages oral presentations
14. In ETE cognitive strategies are clearly developed
15. In ETE a broad range of assessment strategies are used
16. In ETE students are encouraged to discuss concepts and issues
17. In ETE students are encouraged to learn about underlying issues
18. In ETE modular curriculum should be dominant
19. In ETE lab activities reinforce abstract concepts
20. ETE instruction aids in the development of creativity and self-image
21. ETE instruction aids in development of student problem solving
22. ETE instruction aids in development of lifelong learning goals
23. ETE should emphasize interdisciplinary activities

24. ETE lessons should reinforce other schools subjects
25. Students apply other subjects in ETE
26. ETE teachers connect science and mathematics content
27. ETE applies concepts of other subjects
28. ETE leaders should encourage subject matter integration
29. ETE is applied science
30. ETE reflects content of business and industry
31. ETE is guided by technological literacy needs
32. ETE teachers should form interdisciplinary committees
33. ETE programs should reflect interdisciplinary concepts
34. ETE should be available to all students
35. ETE should be focused on the needs of special ed. students
36. ETE should focus on the non-college bound student
37. Research should be conducted on the integration needs in ETE
38. ETE to develop strategies for overcoming stereotypes
39. ETE should be available for all students
40. ETE should focus on the college-prep needs of students

Appendix B

Survey Letter

Dear Engineering/Technology Education Educator:

I am requesting your assistance in completing my dissertation research though Purdue University. Noted below is a web link to a 47 question survey related to the perceptions of classroom engineering/technology teachers in Indiana. The survey should take you no more than five minutes to complete.

www.surveymonkey.com

This survey contains a series of questions about the perceptions of engineering/technology teachers and their opinions, plus a short demographic section. Please complete the survey within two weeks of receiving this email. All responses will be kept anonymous.

If you have any questions about this research project, you can contact Dr. George Rogers at (765) 494-1092 or rogersg@purdue.edu. If you have concerns about the treatment of research participants, you can contact the Committee on the Use of Human Research Subjects at Purdue University, 610 Purdue Mall, Hovde Hall Room 307, West Lafayette, IN 47907-2040. The phone number for the Committee's secretary is (765) 494-5942. The email address is irb@purdue.edu.

Thank you in advance for assisting with this research project and for the professional growth of the teaching profession in Indiana.

Sincerely,
Steve E. Rogers
Steve E. Rogers
Graduate Student

and

George E. Rogers
George E. Rogers, Ed.D., DTE
Professor and Coordinator
Engineering/Technology Teacher Education
401 North Grant Street
Purdue University
West Lafayette, IN 47907-2021

Appendix C

Purdue University Internal Review Board Permission

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	GEORGE ROGERS KNOY 367
From:	RICHARD MATTES, Chair Social Science IRB
Date:	01/04/2011
Committee Action:	**Exemption Granted**
IRB Action Date:	01/04/2011
IRB Protocol #:	1012010155
Study Title:	Perceptions of Indiana's Engineering/Technology Education Classroom Teachers as Measured by t Technology Education Survey

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(2) .

If you wish to revise or amend the protocol, please submit a revision request to the IRB for consideration. Please contact our office if you have any questions.

We wish you good luck with your work. Please retain copy of this letter for your records.

Below is a list of best practices that you should be aware of and keep in mind when conducting your research.

Category 1

- Written permission from preschools, primary and/or secondary schools should be obtained prior to the investigator engaging in research, such as recruitment and conducting research procedures. If the written permission was not submitted with the protocol at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval), the investigator must submit the written permission to the IRB office immediately upon receipt from the school. This is a Human Research Protection Program requirement.

Categories 2 and 3

- Surveys and data collection instruments should note that only participants 18 years of age and over are eligible to participate in the research, state that participation is voluntary and that any questions may be skipped, and include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.

- Written permission from businesses, preschools, primary and/or secondary schools should be obtained prior to the investigator engaging in research, such as recruitment and conducting research procedures. If the written permission was not submitted with the protocol at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval), the investigator must submit the written permission to the IRB office immediately upon receipt from the school. This is a Human Research Protection Program requirement.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the students attendance and enrollment decision will not be known by those administering the course.
- When conducting human subjects research at non-Purdue colleges and universities, investigators are urged to contact that institution#s IRB to determine requirements for conducting research at that institution.
- When conducting human subjects research in places of business, investigators must obtain written permission from an appropriate authority from the business prior to engaging in research activities such as recruitment or conducting study procedures.

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Appendix D

Permission to Use the Characteristics of Technology Education Survey

Steven Rogers

From: Michael Daugherty [mkd03@uark.edu] **Sent:** Thu 4/30/2009 3:50 PM
To: Steven Rogers
Cc:
Subject: RE: CTES Permisson?
Attachments:

Steven,

I would be glad to see you use the instrument and the change that you suggest is appropriate at this time. Please keep me posted on your progress as I would be very interested in your results.

Best Regards,
Mike

-----Original Message-----
From: Steven Rogers [mailto:srogers@warren.k12.in.us]
Sent: Wednesday, April 29, 2009 4:35 PM
To: Michael Daugherty
Subject: CTES Permisson?

Dr. Daughtery,

I am a doctoral student at the Purdue University. I am researching the perceptions of high school engineering/technology education teachers toward pre-engineering programs.

To this end, I would like your permission to use the "Characteristics of Technology Education Survey" (CTES). I found the survey in your article, Technology Education in Transition: Perceptions of Technology Education Teachers, Administrators, and Guidance Counselors. Journal of Industrial Teacher Education, 1996,33(3),6-22. The CTES would be a good instrument to measure the principals' and vice principals' perceptions, but I don't want to use it without your permission. I would like to change the words "Technology Education" to "Engineering/Technology Education".

Please, let me know your thoughts on this at your earliest convenience.

Sincerely,

Steve E. Rogers

Steve E. Rogers
Indiana ACTE President
PLTW POE Master Teacher
Engineering & Technology Education
Walker Career Center
9651 East 21st Street
Indianapolis, IN 46229
317-532-6173

VITA

VITA

Steve E. Rogers
Graduate School, Purdue University

Education
B.S.B.A., Business Management, 2001, University of Nebraska, Lincoln, Nebraska
M.S.T., Secondary Teaching, 2003, University of Nebraska, Lincoln, Nebraska
Ph.D., Engineering and Technology Education, 2012, Purdue University, West Lafayette, Indiana

Professional Experience

- Engineering/Technology Education Department Chair — July 2010 to Present
  Walker Career Center, Indianapolis, Indiana
- Engineering/Technology Education Teacher — August 2006 to Present
  Walker Career Center, Indianapolis, Indiana
- Principles of Engineering Master Teacher — February 2005 to Present
  Project Lead The Way - Pre Engineering Program
- Technology Education Teacher — August 2003 to June 2006
  Kokomo Area Career Center; Kokomo, Indiana
- Industrial Technology Education Student Teacher — January 2003 to May 2003
  Park Middle School; Lincoln, Nebraska
- Graduate Teaching Assistant, (Ind. Technology) — August 2001 to December 2002
  University of Nebraska; Lincoln, Nebraska

Professional Organizations

- Association of Career and Technical Education
- International Technology Education and Engineering Association
- Indiana Association of Career and Technical Education-*Vice President '05-'07, President Elect '08, President '09, Past-President-'10*
- Engineering/Technology Educators of Indiana
- Epsilon Pi Tau
- National Association of Industrial Technology Teacher Educators

Awards

- 2010 Indiana Association of Career and Technical Education Award of Merit
- 2009 Association of Career and Technical Education Region III Award of Merit
- 2009 Outstanding Instruction, Project Lead The Way
- 2008 Indianapolis Power and Light, Golden Apple Award
- 2006 National Association of Industrial Technology Teacher Educators Leaders of Tomorrow Scholarship
- 2006 Outstanding New Career and Technical Teacher, Indiana Association for Career and Technical Education
- Extra Mile Award, Omaha Public Power District - Power Drive Competition (High Mileage Vehicle Program)
- Epsilon Pi Tau- (International Honor Society for Professions in Technology)

Publications and Presentations

- Rogers, S.E. (2011) *Data Driven Instruction.* Presented at Walker Area Career Center Staff Development, Indianapolis IN.
- Rogers, S.E. (2010) *Principles of Engineering Update.* Presented at annual meeting of the Engineering/Technology Educators of Indiana. Indianapolis, IN.
- Rogers, S.E. (2007) *It's Not Just Balsa Wood Bridges Anymore: Reinforced Concrete Bridges*. Paper presented at the annual meeting of the Indiana Association for Career and Technical Education. Indianapolis, IN.
- Rogers, S.E. (2007) *Principles of Engineering and Design Processes; A Comparison of Curricula.* Paper presented at annual meeting of the Technology Educators of Indiana. Indianapolis, IN.
- Rogers, S.E. (2006). At Issue: *Testing Equals Relevance in Technology Education*, *Journal of Industrial Teacher Education, 43*(2).
- Rogers, S.E. (2006) *It's Not Just Balsa Wood Bridges Anymore: Reinforced Concrete Bridges*. Paper presented at the annual meeting of the Association for Career and Technical Education. Atlanta, GA.
- Rogers, S.E. (2005). At Issue: *Technology Education Benefits from the Inclusion of Pre-Engineering Education*, *Journal of Industrial Teacher Education, 42*(3).
- Rogers, S.E. (2004). Under Review: *Manufacturing Facilities Design and Materials Handling*, *Journal of Industrial Teacher Education, 41*(2).
- Rogers, S.E. (2004) *Using Rubrics in Technical Education.* Presented at Kokomo Area Career Center Staff Development, Kokomo IN.
- Rogers, S.E. (2004) *Project Lead The Way and Fischertechniks LL 3.03.* Presented at annual meeting of the Technology Educators of Indiana. Jasper, IN.
- Rogers, S.E. (2003) *Preparing Students for Tomorrow's Careers in Engineering*. Paper presented at the annual meeting of the Association for Career and Technical Education. Orlando, FL.