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The history of educating youth for a career is as old as humanity. Without older generations passing on vital knowledge to younger generations humans would long ago have vanished from the Earth. As the ages progressed and careers became more specialized, career specific education followed. As the Industrial Revolution dawned there were apprenticeship programs for students who wanted to learn a specific skill or trade. Eventually, many of the programs that trained students for a skill or trade found their way into conventional high schools. In America, it was at the high school level where the training of students for a general industrial and technical career began (Scott & Sarkees-Wircenski, 2001). Industrial and technical training became a part of many schools' curriculum, but it had many monikers including: manual arts, industrial education (IE), industrial arts (IA), industrial technology (IT), and finally the name by which it is known today, technology education (TE).

TE has come to encompass many facets of curriculum, ranging from IA to integrating problem-solving and engineering concepts into the curriculum. For technology educators who have chosen the pre-engineering problem-solving route there is a curriculum called Project Lead The Way (PLTW).

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Project Lead The Way (PLTW), a widely recognized pre-engineering curriculum, is described by its creators as, "A four year sequence of courses which, when combined with college preparatory mathematics and science courses in high school, introduces students to the scope, rigor and discipline of engineering and engineering technology prior to entering college" (PLTW, n.d.). PLTW provides engineering focused middle school and high school curriculum. This PLTW curriculum includes specific courses like: Introduction to Engineering Design, Principles of Engineering, Civil Engineering and Architecture, Computer Integrated Manufacturing, and Aerospace Engineering. While PLTW is technical in nature its primary focus is on engineering and engineering technology, thus its content varies from some TE courses. Demonstrating this difference the state of Indiana defines TE as, "An action based program for all students to learn how to develop, produce, use, and asses the impacts of products and services that extend the human potential to improve and control the natural and human-made environment." (IN Curriculum Standards, 2006). By their own definitions PLTW and TE (in the state of Indiana) are similar in concept but do not share exactly the same goals; however, they share enough similarities that PLTW has become an accepted portion of the Indiana TE curriculum (Indiana Department of Education, 2004).

Regardless of the fact that pre-engineering education, in the form of PLTW, is recognized as a valid part of Indiana's TE curriculum it does not necessarily mean that principals of non-PLTW schools in Indiana understand PLTW or how it is implemented. To understand the possible current confusion that Indiana principals face when making decisions related to TE it must first be understood how TE has historically been viewed by Indiana principals. In 1970, when the curriculum was known as IA, Mason (1970) noted that Indiana principals' believed, "Industrial arts should be expanded and strengthened because, as a part of general education, it has value for all students" (p. 54). While principals seemed to support IA, Mason also found 28.0% of principals in Indiana had no experience of any type with IA and only 37.9% had taken an IA related course in college. It is important to note that Mason's study is over 35 years

old and was conducted in a different era, represented by the fact that only 4% of the respondents were female. Nonetheless, Mason's study sets a historical context for the possible lack of Indiana principals' understanding about TE and PLTW.

A more recent study by Hill, Wicklein, and Daugherty (1996) discovered that principals, even those whose schools had exemplary TE departments, believed that TE should not focus on the college-prep needs of students. This prior fact coupled with PLTW's focus on engineering and engineering technology prior to entering college. (PLTW, n.d. b), seems to put it at odds with Hill, Wicklein, and Daugherty's (1996) finding that TE should not focus on the needs of college prep students. The differences in opinion between the principals in Hill, Wicklein, and Daugherty's study and the self-described goal of PLTW could represent a barrier to the implementation of PLTW in Indiana high schools.

Despite documented differences, the pre-engineering movement within TE has grown rapidly and has become an active part of TE. Lewis (2004), who gathered data from, "Telephone calls to several state supervisors for technology," (p. 25) generated information to state that Indiana's goal was to have 40% of schools adopt PLTW. The addition of a new curriculum, in this case PLTW, under the banner of TE is not unique. Prior to the recent addition of engineering and pre-engineering concepts TE had undergone numerous name and curricular changes. TE teachers have not always accepted changes to their curriculum as Rogers and Mahler (1994) discovered that only 17.8% of Nebraska industrial TE teachers, "Indicated acceptance of technology education" (p. 17). Likewise Rogers and Mahler (1994) also found that "Technology education has not been accepted by more than three-fourths (76.25%) of Nebraska and Idaho industrial technology education teachers" (p. 19). Furthermore, Rogers and Mahler surmised that if TE was to be accepted by IA teachers in Nebraska and Idaho that, "Leaders in the field of technology education must interact with industrial arts education teachers in the field through various diffusion activities and not continue to promote technology education change through a top-down approach" (1994, p. 20). With all of the change in TE it is understandable that principals might be reluctant to implement a

curriculum change if the TE teachers in their school were unsure of the curriculum and reluctant to adopt changes. However, this does not appear to be the case with PLTW in Indiana as Rogers (2005) demonstrated that 82.8% of Indiana TE teachers viewed PLTW as valuable or somewhat valuable. If the majority of TE teachers approve of PLTW, has Lewis' (2004) stated goal of 40% not been realized because of possible barriers among Indiana principals?

Statement of the problem

The problem examined by this study concerned the lack of data on principals' perceptions of PLTW from Indiana high schools that had not implemented PLTW before the 2006-2007 school year. The research investigated if the goal of 40% PLTW implementation had not been reached because of possible barriers among Indiana principals.

Purpose of the study

The purpose of this study was to determine what high school principals in Indiana felt were the barriers to the implementation of PLTW curriculum. The research was conducted so those associated with PLTW could have an understanding of what Indiana principals believed were barriers to the implementation of PLTW curriculum. Additionally, the study sought to understand the demographics of principals and schools that are most and least likely to implement PLTW and why only 90 (24.9%) high schools in Indiana, well below Lewis (2004) stated goal of 40%, had implemented PLTW courses before the 2006-2007 school year.

Methodology

The study was a quantitative descriptive study that gathered information from a questionnaire. Best and Kahn (1989) described various types of educational research and suggest the quantitative descriptive study for this type of descriptive research. Respondents' demographic characteristic were described using the descriptors: school size, grade levels present in the school, age of the principal, gender of the principal, undergraduate major of the principal and location of the school (metropolitan or non-metropolitan). The demographic characteristics were analyzed using a Likert-type scale, with a mean and standard deviation calculated for each possible barrier.

Population

The population included non-PLTW public high school and public middle/high school principals in Indiana. The document *List of Indiana Public High School Principals* was obtained from the Indiana Department of Education (2005a). Also, a list of schools teaching PLTW curses was obtained. Of the 361 public high school and middle/high school in Indiana 90 were teaching PLTW courses. The remaining 271 schools were sampled using a random sampling technique. A total of 136 schools (50.18%) were mailed the survey instrument and a cover letter. Of the 136 surveys, 60 (44.12%) were returned. Some returned surveys contained incomplete or missing data; however, all returned surveys were deemed usable.

Instrumentation

The instrument for this study was based on two previous instruments, Mason (1970) and Rogers (2005). The Likert-type portion of the instrument was developed from Mason's study, with input from the graduate committee supervising this study. Mason utilized a Likert-type scale to assess Indiana high school principals' perception of industrial arts in the 1970s. Even though mason's work was over 30 years ago, the structure of the instrument provided a framework for this study's questions. The instrument asked principals to rate possible barriers in one of five categories, and then during statistical analysis the categories were assigned a numeric value in order to calculate a mean. The categories and assigned numeric value were 1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree, and 5 = strongly agree. When calculating the mean of each item 3.0 was assumed to be the dividing point between agree and disagree.

This study used a demographic category exclusive to Mason, undergraduate major. However, the names of many undergraduate education majors have changed since the time of Mason's study; therefore, areas for which the Indiana Department of Education listed academic standards appear on the instrument. Additionally, respondents were asked to list the county where their school resided. Counties were cross-referenced with *Counties With Metropolitan Statistical Areas and Components* (United States Census Bureau, 2004) to determine whether the school was located in a metropolitan or non-metropolitan area. According to the United States Census Bureau (2003), "Metropolitan statistical areas contain at least one urbanized area of 50,000 population or more" (United States Census Bureau, 2003). Any area not meeting the prior criteria was deemed to be non-metropolitan for the purpose of this study. The instrument also asked principals to identify the demographic areas of school size, grade levels present, age and gender.

Survey Information for Indiana Principal Respondents

Demographic information

Principals whose schools had between 251 and 500 students represented the largest range of school size with 38.3% (n = 23) responses. Additionally, two-thirds (n = 40, 66.7%) of the principal respondents represented schools that contained grades 9-12. Just under half of the principals (n = 29, 48.3%) replying to this study were between 51 and 60 years of age. Female principals represented almost one-quarter of the respondents (n = 14, 23.3%). Metropolitan counties represented 55% (n=34) of the respondents. A complete list of the demographics categories and the number of respondents in each category can be found in Table 1.

Principal's undergraduate major

Principals completing the instrument identified their undergraduate major; however, because of respondents who listed dual and "other" majors there were actually 22 categories of majors. Of the 22 categories, 16 had at least one respondent, the complete list of the respondents majors can be found in Table 2.

Overall Survey Questions Representing Possible Barriers to PLTW

Survey responses

After completing the demographic information portion of the survey, respondents rated their perceptions of 15 possible barriers to the implementation of PLTW. It was discovered that 36 principals (65.4%) either agreed or strongly agreed that PLTW is a valid part of TE. Additionally, 35 principals (60.4%) agreed or strongly agreed that PLTW addresses the skills that students should learn in TE. Concerning the offering of PLTW in their school, 33 principals (55.9%) agreed or strongly agreed they would like for their school to offer PLTW. A majority of principals (61.1%, n = 36) strongly agreed or agreed that students in their school would be interested in taking PLTW classes. Thirty-two principals (54.2%) agreed or

Table 1
Demographic Data

	Respondents n = 60	
	n	%
Number of Students		
0-250	7	11.7%
251-500	23	38.3%
501-750	10	16.7%
751-1000	5	8.3%
1000 or more	15	25.0%
Grade Levels Present		
Grades 7-12	20	33.3%
Grades 9-12	40	66.7%
Age of the Principal		
20-30 years of age	1	1.7%
31-40 years of age	8	13.3%
41-50 years of age	19	31.7%
51-60 years of age	29	48.3%
61 or more years of age	3	5.0%
Gender of the Principal		
Female	14	23.3%
Male	46	76.7%
Location of the School		
Metropolitan	33	55.0%
Non-Metropolitan	27	45.0%

Table 2
Undergraduate Major(s) of Indiana Principal Respondents

Undergraduate Major(s) of Indiana Principals	n	%
Social Studies	14	23.3%
Physical Education	10	16.7%
English/Language Arts	6	10.0%
Business and Marketing Education	6	10.0%
Music/Visual Arts	5	8.3%
Mathematics	4	6.7%
Health & Physical Education	3	5.0%
Science	2	3.3%
Technology Education	2	3.3%
Other	2	3.3%
Family and Consumer Sciences	1	1.7%
World Languages	1	1.7%
Special Education	1	1.7%
Mathematics & Physical Education	1	1.7%
Theatre & Speech	1	1.7%
Social Studies & Physical Education	1	1.7%

strongly agreed that school corporation administrators would support PLTW. Furthermore, 25 principals (47.1%) agreed or strongly agreed that school board members of their corporation would support PLTW and 31 principals (53.4%) strongly agreed or agreed that members of their community would support PLTW. Rating their own familiarity with PLTW, 37 principals (62.7%) agreed or strongly agreed they were familiar with the PLTW curriculum. Twenty-four principals (45.3%) agreed, or did so strongly, that the cost of PLTW equipment was too expensive. Moreover 25 principals (42.4%) agreed or strongly agreed the cost of training PLTW teachers was too expensive. Concerning federal funding, 35 principals (59.3%) agreed or strongly agreed they were aware that PLTW programs were eligible for Perkins funding. Twenty principals (34.5%) agreed or strongly agreed that TE teacher(s) in their school would like to offer PLTW. Likewise, 17 principals (29.3%) agreed or strongly agreed that TE teachers in their school would be willing to attend PLTW summer training sessions. Twenty-four principals (43.6%) disagreed or disagreed strongly that students in their school would not have time for PLTW because of core classes. Another 22 principals (37.3%) disagreed or disagreed strongly that adding PLTW would mean removing all other TE classes. An overall list of the means and standard deviations for responses to possible barriers can be found in Table 3 and it is important to note that the total n for some responses may contain an n less than the total n (n = 60) because one or more respondent may have chosen not to answer a given question.

Survey Questions by Demographic Descriptors

School Size

The distinctions in each of the six demographic areas were analyzed to determine how each demographic responded to the instrument. In some demographic areas the small number of respondents caused categories to be merged for increased validity, these differences will be noted in various tables when compared to Table 1. Principals of schools with more than 1001 students ranked

Table 3
Overall Survey Responses

	n	M	SD
I believe PLTW is a valid part of technology education	55	3.9	0.83
PLTW addresses the skills that students should learn in technology education	58	3.8	0.77
This community would support the offering of PLTW classes	58	3.7	0.83
I would like for this school to offer PLTW classes	59	3.7	0.85
Students in this school would be interested in taking PLTW classes	59	3.7	0.73
School corporation administrators would support PLTW	59	3.7	0.91
The cost of PLTW equipment is too expensive	53	3.6	0.91
I am aware that PLTW programs are eligible for Perkins funding	59	3.6	1.16
School board members would support PLTW	56	3.5	0.76
I am familiar with the PLTW curriculum	59	3.5	1.26
The cost of training PLTW teachers is too expensive	59	3.4	0.84
Technology education teacher(s) in this school would like to offer PLTW classes	58	3.3	0.90

Table 3 (continued)

Table 3 (continued)

Technology education teacher(s) in this school would be willing to attend PLTW summer training sessions	58	3.2	0.91
Students in this school would not have time for PLTW, because of core classes	55	2.8	0.90
Adding PLTW will mean removing all other technology education classes	59	2.7	0.89

their familiarity with the PLTW curriculum with a mean of 4.1 (SD = 0.86) while principals of schools with 501-1000 and 500 or fewer students rated it with a mean of 3.3 (SD = 1.23) and 3.2 (SD = 1.35) respectively. With a mean of 4.1 (SD = 0.96) principals of schools with more than 1001 students (M = 4.1, SD = 0.96) agreed they were aware that PLTW programs were eligible for Perkins funding; however, principals of schools with 501-1000 students (M = 3.3, SD = 1.23) and less than 500 students (M = 3.2, SD = 1.35) agreed to a lesser extent. Regarding PLTW summer training session(s), principals who had 1001 or more students agreed (M = 3.7, SD = 0.82) TE teachers in their school would attend summer training while principals with 501-1000 students disagreed with a mean of 2.9 (SD = 0.74). Complete data regarding the beliefs of principals from various school sizes can be found in Table 4.

Grade Levels Present

Principals of grade 9-12 buildings agreed they were more familiar (M = 3.6, SD = 1.18) with the PLTW curriculum than were grade 7-12 principals (M = 3.1, SD = 1.37). Principals of grade 9-12 buildings (M= 3.7, SD = 1.13) also rated their understanding of how PLTW relates to Perkins funding higher than did grade 7-12 principals (M = 3.3, SD = 1.19). For additional information about how principals of both 7-12 and 9-12 buildings viewed PLTW please see Table 5.

Table 4
Means Based on School Size

	500 or Fewer Students			501-1000 Students			1001 or More Students		
	n	M	SD	n	M	SD	n	M	SD
I believe PLTW is a valid part of technology education	28	3.8	0.84	15	3.7	0.80	12	4.3	0.75
I would like for this school to offer PLTW classes	29	3.7	0.75	15	3.5	0.92	15	3.9	0.96
School corporation administrators would support PLTW	29	3.7	0.80	15	3.5	0.92	15	3.8	1.15
Students in this school would be interested in taking PLTW classes	29	3.7	0.76	15	3.5	0.74	15	3.9	0.64
PLTW addresses the skills that students should learn in technology education	29	3.7	0.81	15	3.7	0.72	14	4.1	0.66
This community would support the offering of PLTW classes	29	3.7	0.81	15	3.5	0.83	14	4.1	0.77
School board members would support PLTW	28	3.5	0.69	15	3.2	0.77	13	3.8	0.80
The cost of PLTW equipment is too expensive	27	3.5	0.94	14	3.8	0.80	12	3.5	1.00
I am aware that PLTW programs are eligible for Perkins funding	29	3.3	1.26	15	3.5	1.06	15	4.1	0.96
The cost of training PLTW teachers is too expensive	29	3.3	0.81	15	3.5	0.92	15	3.6	0.83

Table 4 (continued)

Table 4 (continued)

	n	M	SD	n	M	SD	n	M	SD
Technology education teacher(s) in this school would like to offer PLTW classes	29	3.3	0.84	15	3.1	0.80	14	3.6	1.08
I am familiar with the PLTW curriculum	30	3.2	1.35	15	3.3	1.23	14	4.1	0.86
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	28	3.1	0.97	15	2.9	0.74	15	3.7	0.82
Students in this school would not have time for PLTW, because of core classes	28	2.8	0.80	15	2.9	0.80	12	2.7	1.23
Adding PLTW will mean removing all other technology education classes	29	2.7	0.96	15	3.1	0.59	15	2.4	0.91

Table 5

Means Based on Grade Levels Present

	Grades 7-12			Grades 9-12		
	n	M	SD	n	M	SD
PLTW addresses the skills that students should learn in technology education	19	3.8	0.76	39	3.7	0.79
I believe PLTW is a valid part of technology education	19	3.8	0.85	36	3.9	0.82
Students in this school would be interested in taking PLTW classes	19	3.7	0.75	40	3.7	0.72
School corporation administrators would support PLTW	19	3.7	0.89	40	3.7	0.94

Table 5 (continued)

Table 5 (continued)

I would like for this school to offer PLTW classes	19	3.6	0.84	40	3.8	0.86
This community would support the offering of PLTW classes	19	3.6	0.90	39	3.8	0.79
The cost of PLTW equipment is too expensive	18	3.6	1.04	35	3.6	0.85
School board members would support PLTW	19	3.5	0.70	37	3.5	0.80
The cost of training PLTW teachers is too expensive	19	3.5	0.90	40	3.4	0.81
I am aware that PLTW programs are eligible for Perkins funding	19	3.3	1.19	40	3.7	1.13
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	18	3.2	0.71	40	3.2	1.00
Technology education teacher(s) in this school would like to offer PLTW classes	19	3.2	0.90	39	3.4	0.91
I am familiar with the PLTW curriculum	20	3.1	1.37	39	3.6	1.18
Adding PLTW will mean removing all other technology education classes	19	2.9	1.03	40	2.6	0.81
Students in this school would not have time for PLTW, because of core classes	18	2.7	0.83	37	2.8	0.94

Age of the Principal

All age ranges of principals rated as their highest mean the statement that PLTW is a valid part of TE; however, it was less agreed upon by those principals 40 years of age or less (M = 3.4, SD = 0.73), than the other ranges, including 41-50 years of age (M = 4.0, SD = 0.82), and 51 or more years of age (M = 3.9, SD = 0.85). In

another example of disparity, principals 41-50 years of age (M = 4.0, SD = 0.82) believed school corporation administrators would support PLTW; likewise, principals aged 40 years or less (M = 3.4, SD = 0.73), agreed but to a lesser degree. Principals 41-50 years of age believed more strongly that they would like to offer PLTW (M = 4.0, SD = 0.88) than did principals age 40 or less years of age (M = 3.3, SD = 0.71). Principals 41-50 years of age agreed they were familiar with PLTW (M = 3.9, SD = 1.03); conversely, those less than 40 years of age disagreed (M = 2.4, SD = 1.33). Both the group of principals 41-50 years of age and 51 and more years of age believed with a mean of 3.8 (SD = 0.85, SD = 0.56) that students in their school would be interested in taking PLTW classes; however, their counterparts 40 years of age and younger agreed (M =3.2, SD = 0.83) but not as strongly. Principals 40 or less years of age disagreed (M = 2.9, SD = 0.78) that TE teachers in their school would like to offer PLTW; in opposition, principals 41-50 years of age (M = 3.5, SD = 0.84) and 51 or more years of age (M = 3.3, SD = 0.95) agreed.

Principals 40 years of age or less disagreed (M = 2.6, SD = 0.88) that TE teachers in their school would be willing to attend the summer training sessions; in contrast, principals 41-50 years of age (M= 3.3, SD = 1.05) and principals 51 or more years of age (M = 3.4, SD = 0.76) agreed. Principals 40 and less years of age (M = 3.1., SD = 0.60) agreed that students in their school would not have time for PLTW classes; on the other hand, principals 41-50 years of age (M = 2.6, SD = 0.83) and 51 and older (M = 2.8, SD = 1.01) disagreed. Principals' age seemed to affect their opinion of PLTW; however, the small number of principals younger than 40 years of age (n = 9, 15%) may be one of the factors that led to these results. The findings of each statement based on a principal's age can be found in Table 6.

Gender

Female principal respondents consisted of slightly less than one-quarter of the total respondents but their input provided valuable data about the role that gender can play on a principal's perception of PLTW. Female principals (M = 4.2, SD = 0.70) agreed they would like for their school to add PLTW; likewise, male principals agreed

Table 6

Means Based on Age

	Age 40 or Younger			Age 41-50			Age Older Than 51		
	n	M	SD	n	M	SD	n	M	SD
I believe PLTW is a valid part of technology education	9	3.4	0.73	19	4.0	0.82	27	3.9	0.85
School corporation administrators would support PLTW	9	3.4	0.73	19	4.0	0.82	31	3.6	0.99
I would like for this school to offer PLTW classes	9	3.3	0.71	19	4.0	0.88	31	3.6	0.84
PLTW addresses the skills that students should learn in technology education	9	3.3	0.71	19	3.8	0.69	30	3.9	0.82
School board members would support PLTW	9	3.3	0.50	19	3.6	0.68	28	3.5	0.88
The cost of training PLTW teachers is too expensive	9	3.2	0.44	19	3.6	0.69	31	3.4	0.99
The cost of PLTW equipment is too expensive	9	3.2	0.44	18	3.7	1.02	26	3.6	0.94
Students in this school would be interested in taking PLTW classes	9	3.2	0.83	19	3.8	0.85	31	3.8	0.56
This community would support the offering of PLTW classes	9	3.2	0.67	19	3.9	0.85	30	3.8	0.82
Students in this school would not have time for PLTW, because of core classes	9	3.1	0.60	19	2.6	0.83	27	2.8	1.01

Table 6 (continued)

Table 6 (continued)

Technology education teacher(s) in this school would like to offer PLTW classes	9	2.9	0.78	19	3.5	0.84	30	3.3	0.95
I am aware that PLTW programs are eligible for Perkins funding	9	2.8	1.48	19	3.8	1.07	31	3.6	1.05
Adding PLTW will mean removing all other technology education classes	9	2.7	0.50	19	2.7	1.00	31	2.8	0.92
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	9	2.6	0.88	19	3.3	1.05	30	3.4	0.76
I am familiar with the PLTW curriculum	9	2.4	1.33	19	3.9	1.03	31	3.5	1.23

(M = 3.6, SD = 0.84) but to a lesser extent. Female principals rated as their highest mean the statement that school corporation administrators would support PLTW (M = 4.2, SD = 0.70); male principals also agreed (M = 3.5, SD = 0.92); but again to a lesser extent. Additionally, female principals (M = 4.2, SD = 0.70) believed more strongly than did male principals (M = 3.6, SD = 0.82) that members of their community would support PLTW. Female principals also (M = 4.1, SD = 1.07) agreed more strongly than did male principals (M = 3.3, SD = 1.27), that they were familiar with the PLTW curriculum.

Even though female principals positively agreed with many statements about PLTW, they also agreed more strongly (M = 3.9, SD = 0.86) than their male counterparts (M = 3.5, SD = 0.91) that PLTW equipment was too expensive. However, female principals (M = 4.0, SD = 1.11) also agreed more strongly than male principals

(M = 3.4, SD = 1.16) that they were aware that PLTW programs were eligible for Perkins funding. On the issue of whether adding PLTW would mean removing all other TE classes, female principals (M = 2.4, SD = 0.94) disagreed more strongly than did male principals (M = 2.8, SD = 0.86). Likewise, female principals (M = 2.4, SD = 0.96) disagreed to a greater extent than male principals (M = 2.9, SD = 0.85) that students in their school would not have time for PLTW because of core classes. A complete list of how male and female principals responded to all the statements can be found in Table 7.

Table 7
Means Based on Gender

	Female Principals			Male Principals		
	n	M	SD	n	M	SD
I would like for this school to offer PLTW classes	14	4.2	0.70	45	3.6	0.84
School corporation administrators would support PLTW	14	4.2	0.70	45	3.5	0.92
This community would support the offering of PLTW classes	14	4.2	0.70	44	3.6	0.82
I am familiar with the PLTW curriculum	14	4.1	1.07	45	3.3	1.27
I believe PLTW is a valid part of technology education	14	4.1	0.92	41	3.8	0.81
I am aware that PLTW programs are eligible for Perkins funding	14	4.0	1.11	45	3.4	1.16
PLTW addresses the skills that students should learn in technology education	14	3.9	0.83	44	3.7	0.76

Table 7 (continued)

Table 7 (continued)

Students in this school would be interested in taking PLTW classes	14	3.9	0.83	45	3.6	0.68
The cost of PLTW equipment is too expensive	14	3.9	0.86	39	3.5	0.91
School board members would support PLTW	14	3.8	0.58	42	3.4	0.80
The cost of training PLTW teachers is too expensive	14	3.6	0.94	45	3.4	0.81
Technology education teacher(s) in this school would like to offer PLTW classes	14	3.6	1.02	44	3.2	0.86
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	13	3.5	1.05	45	3.1	0.87
Adding PLTW will mean removing all other technology education classes	14	2.4	0.94	45	2.8	0.86
Students in this school would not have time for PLTW, because of core classes	13	2.4	0.96	42	2.9	0.85

Undergraduate Major

Principals had 22 majors from which to choose on the instrument; however, for the purpose of statistical analysis, principals were divided into two groups, those whose undergraduate major had been an Indiana core subject area and those whose undergraduate major had not been a core Indiana subject. Principals whose undergraduate major was a core subject area (M = 3.8, SD = 0.71) and those whose major was a non-core subject area (M = 3.8, SD = 0.83) agreed that PLTW addresses the skills students should learn in TE. Furthermore, principals whose undergraduate major was

a core subject area (M = 3.7, SD = 0.76) and a non-core subject area (M = 3.7, SD = 0.93) agreed they would like for their schools to offer PLTW. Principals whose undergraduate major had been a core area (M = 3.1, SD = 1.00) agreed students would not have time for PLTW classes because of core classes; whereas principals whose undergraduate major had been a non-core area (M = 2.5, SD = 0.72) disagreed. It is important to note that in Table 8 the total of each category may be greater than the total number of respondents (n = 60) because some principals had dual majors of which one was core and one was not.

Table 8
Means Based on Undergraduate Major

	Core Major			Non-Core Major		
	n	M	SD	n	M	SD
I believe PLTW is a valid part of technology education	23	3.8	0.72	34	3.9	0.90
PLTW addresses the skills that students should learn in technology education	26	3.8	0.71	34	3.8	0.83
I would like for this school to offer PLTW classes	27	3.7	0.76	34	3.7	0.93
School corporation administrators would support PLTW	27	3.7	0.73	34	3.8	1.05
This community would support the offering of PLTW classes	26	3.7	0.75	34	3.9	0.89
Students in this school would be interested in taking PLTW classes	27	3.5	0.75	34	3.9	0.67
I am aware that PLTW programs are eligible for Perkins funding	27	3.4	1.34	34	3.7	1.00

Table 8 (continued)

Table 8 (continued)

The cost of PLTW equipment is too expensive	23	3.4	0.66	32	3.7	1.02
Technology education teacher(s) in this school would like to offer PLTW classes	26	3.4	0.85	34	3.3	0.98
School board members would support PLTW	24	3.4	0.82	34	3.6	0.73
I am familiar with the PLTW curriculum	27	3.3	1.36	34	3.6	1.18
The cost of training PLTW teachers is too expensive	27	3.3	0.67	34	3.6	0.92
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	27	3.1	0.86	33	3.3	0.99
Students in this school would not have time for PLTW, because of core classes	25	3.1	1.00	32	2.5	0.72
Adding PLTW will mean removing all other technology education classes	27	2.8	0.74	34	2.6	1.02

Metropolitan and Non-Metropolitan

Metropolitan principals (M = 3.5, SD = 0.72) agreed that TE teachers in their school would like to offer PLTW to a greater degree than did principals in non-metropolitan principals (M = 3.1, SD = 1.01). There were only a few slight differences of opinion based on metropolitan and non-metropolitan classification, these differences can be found in Table 9.

Table 9
Sorted Means Based on County Classification

	Metro Principals			Non-Metro Principals		
	n	M	SD	n	M	SD
I believe PLTW is a valid part of technology education	29	3.9	0.72	26	3.8	0.91
PLTW addresses the skills that students should learn in technology education	31	3.7	0.63	27	3.8	0.89
This community would support the offering of PLTW classes	31	3.7	0.78	27	3.7	0.86
I would like for this school to offer PLTW classes	32	3.6	0.83	27	3.8	0.85
I am aware that PLTW programs are eligible for Perkins funding	32	3.6	1.13	27	3.5	1.19
School corporation administrators would support PLTW	32	3.6	0.95	27	3.8	0.85
Students in this school would be interested in taking PLTW classes	32	3.6	0.67	27	3.8	0.74
I am familiar with the PLTW curriculum	32	3.5	1.30	27	3.4	1.21
The cost of PLTW equipment is too expensive	31	3.5	0.89	22	3.7	0.94
School board members would support PLTW	30	3.5	0.68	26	3.5	0.81
Technology education teacher(s) in this school would like to offer PLTW classes	31	3.5	0.72	27	3.1	1.01

Table 9 (continued)

Table 9 (continued)

The cost of training PLTW teachers is too expensive	32	3.4	0.76	27	3.4	0.93
Technology education teacher(s) in this school would be willing to attend PLTW summer training session	32	3.2	0.91	26	3.2	0.88
Students in this school would not have time for PLTW, because of core classes	29	2.9	0.96	26	2.7	0.80
Adding PLTW will mean removing all other technology education classes	32	2.8	0.91	27	2.7	0.81

Conclusions and Recommendations

Conclusions

Using 3.0 as baseline for judging agreement and disagreement the study found that as a group non-PLTW principals in Indiana believed that PLTW was a valid part of the TE curriculum. Furthermore, non-PLTW principals believed that PLTW addressed the skills that students should learn in TE. Likewise, almost all demographic groups disagreed that students would not have time for PLTW because of core classes and adding PLTW would mean removing all other TE classes. Regardless of the fact that non-PLTW Indiana principals agreed that PLTW was a useful and valid part of the TE curriculum they believed the greatest barrier to implementing PLTW was cost, both of the cost of PLTW equipment and of the PLTW summer training.

When non-PLTW Indiana principals were distributed into various demographic categories, it was discovered that the demographics of age and gender had the greatest affect on the perception of PLTW. Principals younger that 40 years of age indicated that the cost of implementing PLTW was a barrier, additionally they were unaware of possible funding sources for the program. These younger principals were also less familiar with the

PLTW curriculum than their older counterparts. The finding of age as a possible barrier is important because Jones and Walls (1994) found, "No significant differences in perception due to age," (p. 18) concerning Mississippi principals' view on the integration of vocational education into academic curriculum. Likewise Rogers (2007) study of Indiana PLTW principals found, "No significant difference," (p. 54) concerning a principals' age and the way they view the effect of PLTW on high school students. This study did not involve a statistical test of significance; regardless, the study found that principals 40 years of age or less have lower perceptions of PLTW than principals of any other age or of any other demographic group.

Conversely, female principals are the demographic that have the highest perceptions of PLTW. Female principals were the only demographic group to agree with more than one statement about PLTW with a mean at or above 4.0. This finding is similar to Rogers (2007) who noted "Female principals rated PLTW's effect on the motivation and enthusiasm of their students higher than their male counterparts" (p. 54). However, Rogers ultimately decided there were, "No significant differences were indicated between male and female PLTW principals" (p. 54) regarding the perception of PLTW among PLTW high school principals in Indiana. Again, this study did not involve a statistical test of significance but the ratings of female principals are similar to those discovered by Rogers (2007). Female principals also were less concerned about PLTW consuming a student's schedule than their male counterparts. Overall, divisions among and between other demographic groups affected some views of PLTW but none were as polarized as that of age and gender.

Discussion and recommendations

Despite the fact that non-PLTW principals believe PLTW is valid part of the TE curriculum, it address the skills that students should learn in TE, the community and the school would like to offer the courses, and students would be interested in taking PLTW courses it has not been implemented to the extent described by Lewis (2004). The primary barrier, according to the principals that responded to this study, was the cost of implementing PLTW in their

school. The concept of cost as a barrier was identified by 24 (45.3%) respondents who believed the cost of PLTW equipment was too expensive. Furthermore, principals agreed they knew that PLTW was available for Perkins funding. Twenty-five (42.4%) of the respondents either agreed or agreed strongly that they were aware that PLTW was eligible for federal funding. In contrast to the principals' perceived cost of implementing PLTW Rogers (2005) noted:

> In order to facilitate a positive implementation of the PLTW curriculum across the state, funding opportunities were made readily available to schools and teachers. This funding was in the form of grants from the Indiana Department of Education and the Indiana Department of Workforce Development. Through this process, teachers who chose to be involved could demonstrate their commitment and then have their pre-engineering programs funded. Once in place, the pre-engineering curriculum received ongoing funding via federal career and technical education funding through the Indiana Department of Workforce Development. (p. 10)

Contrary to how principals' responded to the questions for this study it seems as though the information about funding described in Rogers (2005) study was not known or well understood by the principals responding to this study. Perhaps this confusion is understandable as the *2007 Cost Estimates for PLTW Courses* found on the PLTW website lists the cost of the required computer lab as "35,369.60" (PLTW, n.d. a) and the cost of the three high school foundation classes, Introduction to Engineering Design, Digital Electronics, and Principals of Engineering as: "$3,353.11, $8,169.76, $20,238.81," (PLTW, n.d. a) respectively. Likewise this same data does not mention possible state or federal funding. Therefore, the information gathered in this study could be used to conduct outreach activities for Indiana principals who may not support PLTW but may not have all information that is relevant to funding a PLTW program. Outreach activities could be conducted by PLTW, PLTW affiliate professors, or those at the Indiana Department of Education.

Due to the limitations of this study, the low number of respondents in some demographic areas and the possibility that these discrepancies skewed some of the findings, there are four recommendations for further research.

a. The study should be replicated at a later time when the classification of counties, as defined by the United State Census Bureau, has changed.

b. The study should be replicated in another state where PLTW is a recognized portion of the TE curriculum.

c. The study should be replicated with principals' gender being a determining factor in sample selection.

d. The study should be replicated with principals' age being a determining factor in the sample selection.

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