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Bits and Pieces

Saying Goodbye to JITE

It is with great difficulty and sadness that I have to be the one to report that this will be the last issue of JITE. When I took over the editorship of JITE a year and a half ago I never dreamed I would be the last editor of this beloved journal. JITE has always been the premier research journal for the past 50 years and still is today. There are not many journals left where Technology Education professionals can publish their research findings and this is the only one dedicated solely to Industrial Technology Education. It has been around for as long as I have been involved in technology education dating back to 1974 when I first stated teaching.

So what happened that brought about the end of JITE? It wasn't politics or the economy, it was **apathy**! If there is one thing sadder than the end of JITE, to me it is the real reason it ended when it didn't have to. The end has been coming for a long time. It seems that those in technology education don't want to be involved in supporting the organization anymore, they only want to publish for their personal rewards, keeping it operational does not interest them any more. I say this after observing what has been happening for the past year and a half. Many positions have been left open because no one will volunteer to support JITE. The work created by the open positions have left the work for a very few to do. We have now gone to paying a part time person to do what was previously done by volunteers. In my case I should have had an associate editor to assist me and take over the editorship after my two years were complete but have not been able to find one. I have agreed to continue in this position for one more year. During the coming year I will help with the start up of a new journal, which will be called JSTE. I am doing this in hopes that it will be as successful as JITE. Hopefully I will be able to find an assistant editor outside the Technology Education field to take over the new journal.

Enough of the bad news, there is some good news. While the JITE board of directors did decide to end JITE they wanted to continue the great research tradition started by JITE so they have created a new journal (JSTE) that will begin with the very next issue Volume 47-2. This new journal will cover a wider range subjects in an effort to draw in more readers, and inspire more authors to submit their research. The new JSTE journal will cover areas in the Science, Technology, Engineering and Math Teacher Education (STEM) fields. The new journal does not come without a price. A new set of rules have been developed in order to submit manuscripts for publications. Be sure to read the AT ISSUE article in this volume that will explain all the new requirements.

In this Last Issue of JITE

In the At Issue article, George Rogers explains some of the reasons for the demise of JITE, and the future of JSTE. Be sure to read this article. David Bjorkquist reviewed one of the hottest selling books in the technology education fields, *Shop Class as Soulcraft: An Inquiry Into the Value of Work* by Matthew Crawford (2009). In this excellent book Crawford calls for the revival of skills like tool, machine, and material use in our public school system. The complete review of this book can be found in the Under Review section.

Volume 47-1 may be the last for JITE but it is a perfect beginning for JSTE. Reading the research presented in it one can see that the manuscripts are directed towards increasing student awareness in the technology education field. Leading off is research conducted by Kara Harris and Christi Jacobs in "Educational Camps and Their Effects on Female Perceptions of Technology Programs" and describes the effect of a four day cheering camp to increase female awareness and perceptions of technology fields. The camp targeted high school cheerleaders and dance students and gave them the latest hands-on technology related to cheering and dance. "Identifying Perceived Professional Development Needs of Secondary CTE Teachers: Pedagogical Needs of Skilled and Technical Science Teachers" by John Cannon, Allen Kitchel, and Dennis Duncan researched the purpose of skilled and technical science teachers' needs in teaching and learning in pedagogical in-service content areas. Their research is followed by research conducted by Petros Katsioloudis that identifies methods needed to aid the teachers of technology education, present information that will enable students to have a better understanding of the topic being presented and at the same time motivate students. Petros's research can be found in his manuscript "Identification of Quality Visual-based Learning Material for Technology Education". While Petros's research deals with methods to help improve student learning, Cameron Denson and Roger Hill's research examined the impact of an engineering mentorship program for African American male high school students and their perceptions of self-efficacy in the area of mathematics, and self-efficacy in the area of science. Their research findings can be found in their manuscript "Impact of an Engineering Mentorship Program on African-American Male High School Students' Perceptions and Self-Efficacy". This research is the last for JITE and is a perfect lead in for our new journal JSTE and meets all the qualifications for Science, Technology, and Engineering and Math teacher education.

I am looking forward to the new JSTE journal and hope it will be as successful as JITE was in the past, but we need more support from everyone to make it successful. It's time to get involved.

I would like to end with a big **Welcome to the new JSTE!**

Association for sTEm Teacher Education
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"Call for Manuscripts"

Journal of sTEm Teacher Education

The *Journal of sTEm Teacher Education* is published three times annually by the Association for sTEm Teacher Education. The *Journal*, formerly the *Journal of Industrial Teacher Education*, was first published in 1963 and is one of the most respected refereed journals in the profession. Past copies of the *Journal* can be accessed at: http://scholar.lib.vt.edu/ejournals/JITE/.

The *Journal's* refereed articles can be in one of three categories: 1) research-based manuscripts, 2) conceptual pieces, and 3) dissertation-based manuscripts. Additionally "At Issue" essays, "Comments," and "Under Review" (reviews of books and media) are published. All published work focuses on science, engineering, technology, and mathematics (STEM) teacher education, with a dedicated emphasis on the T&E of STEM.

Submission Requirements

All manuscripts submitted for publication must be accompanied by a cover letter that specifies the section of the *Journal* for which the manuscript is intended and an abstract that describes the essence of the manuscript in 150 words or less. Manuscripts must conform with the guidelines provided in the *Publication Manual of the American Psychological Association*. Use APA's "place table here" in the text for tables and figures, and place them at the end of the manuscript. Manuscripts should be submitted in electronic form as email attachments or as files on a CD/ disk.

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Manuscripts that do not meet submission requirements will be retuned outright to the author. Manuscripts must be the original work of the author(s) and not have been published, be awaiting publication, or under publication considering by another source. Authors must be current members of the Association for sTEm Teacher Education. (Membership details attached.)

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Educational Camps and Their Effects on Female Perceptions of Technology Programs

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Abstract

The purpose of this study was to investigate the impact of Cheering in the Classroom, a four-day program designed purposefully to increase female awareness and perceptions of technology fields. The camp included discipline-based activities from the 13 different programs of study based in technology. The camp targeted high school cheerleaders and dancers, allowing them the opportunity to engage in hands-on-activities and competitions using new technology that was directly related to the cheerleading or dance. Each activity allowed the participants to see how technology can be used to understand and improve cheerleading/dance activities. The study compared participant's perceptions of the Cheering in the Classroom camp to the perceptions of the TEAM (Technology Expanding All Minds) camp. Data were collected with the use of a Lyket-type scale through pre and post surveys. Responses from the survey calculated participants' awareness and perceptions of technology to determine the effectiveness of the Cheering in the Classroom camp. Results of the study indicated that the cheering in the classroom camp had a more positive influence on participants perceptions of technology,

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leading the researcher to believe that building recruitment initiatives based upon participant personal interests can aid in positive perceptions of technology and technological careers.

Background

In the past 15 years, numerous reports have identified low numbers of females working in technology related fields (National Science Foundation) [NSF], 2002, 2003a, 2003b). This could be due in part to the fact that society does not always encourage females to pursue nontraditional careers in technical areas (Morris, 2002). However, several efforts on multiple levels to increase the number of females in technology have been attempted. Present efforts to improve gender equity in technology have failed to make any significant impact (NSF, 2003). This is a concerning issue because as noted by Zuga (1999, p. 1) women are natural “technologists” who have been a part in creating our world. However, females in engineering and technology have worked with a male dominated culture with “male driven philosophy” and male “paradigms in society” for years (Zuga).

Although a small increase in female participation in high school technology education classrooms has been noted, data indicates that more attention has been focused on preparing males than females for futures in technology (Welty & Puck, 2001). There is need to recognize the importance of educating all students to realize the opportunities that are available to them in technology. In Wisconsin 80% of the jobs available require a technical background, which heightens the importance of training all populations, both represented and underrepresented, in technology (Welty & Puck, 2001). In addition, it has been discovered that females are attracted to subjects that demand the exercise of highly developed inter-personal as well as intellectual skills, which are commonly needed skills in technical and engineering careers (Siann, 1997).

Smith (2000) suggested that relating technology to a variety of subjects would help engage students in the learning process. This study examined if relating technology to a favorite activity or specific interest, such as cheerleading, would increase the recruitment rate of females into technology majors at the post-secondary level.

As mentioned before, technology has traditionally been a male dominated field. Due to the lack of females in technology, the global market suffered the loss of innovations that women could have brought to different professions within technology (Metz, 2006). This study was designed to examine an innovative way to recruit females into the field of technology. The advancements that females could contribute to the technology majors are endless (Shanahan, 2006). Silverman (1999) noted that:

> Experience has shown that women are interested in nontraditional occupations when they are actively recruited. Female high school students who are good at math and science and enjoy hands-on technology projects often turn away from higher level classes in these subjects because they are not aware of the kind of nontraditional careers available to them and cannot see themselves in technical or scientific jobs (p. 3).

In addition, studies show that females are turned away by the gender stereotypes and feel a need to avoid certain classes in school due to stereotypes (Oregon State University Extension Service, 2005). With the additional innovations that females can bring to the field of technology, our society can achieve higher levels of technological success (Darby & Bland, 1994).

Increasing the number of females in technology has been an ongoing issue. If more effective recruitment in technology is not developed it is expected that there will be a decreasing number of females entering the technology and engineering fields. Tallow noted, “The world cannot afford the loss of the talents of half its people if we are to solve the many problems which beset us” quoted Nobel Laureate Rosalyn Tallow (NSF, 2003a, p.178).

Purpose and Research Questions

The purpose of this study was to determine the effectiveness of a pilot recruitment program designed to recruit females into technology majors at the post-secondary level. Data from a traditional technology recruitment camp, TEAM, and a pilot recruitment program, the Cheering in the Classroom camp were compared. The TEAM camp was designed to recruit female participants into postsecondary technology majors through various academic activities. The cheer camp had an identical goal but was designed to relate technology activities to cheerleading activities.

From the literature reviewed, it was discovered that gender equity was not a new problem, but an ongoing problem in need of further research. Although advancements in gender equity have been made, these advancements are not enough. The fields of Science, Technology, Engineering and Mathematics (STEM) currently have a shortage of females in the workplace and universities. This study does not solve the STEM shortage, but looks at a small portion of the post-secondary recruitment solution. This study determined if a nontraditional camp was more successful in helping females to become interested in technology majors. The study was designed to explore following questions:

1. Did attending the Cheering in the Classroom or TEAM camp affect participant's perceptions concerning technology?
2. Did attending the Cheering in the Classroom or TEAM camp increase participant's awareness of various college majors within the academic discipline of technology?
3. Which camp, Cheering in the Classroom or TEAM, had a greater influence on participants.

Significance of the Problem

Males working in the field of technology outnumber females four to one (Sciannamea, 1997). In addition, research indicates that male and female brains process language, information, emotion, cognition, etc. differently (Sabbatini, 1997). When the shortage of females in technology was combined with the fact that each gender processes information and solves problems differently, a gap in potential technological progress arose. Not utilizing diversity, our society has been omitting possible technological advancements. Wulf, the President of the National Academy of Engineering, stated that with our lack of diversity "we pay an opportunity cost, a cost in designs not thought of, in solutions not produced" (Metz, 2006, p. 2).

By 2020, the federal labor department forecasts that the United States will need to import seventy percent of the engineers and technicians that American industries need to maintain the nation's current quality of life (NSF, 2003). Despite the millions of dollars spent on trying to overcome the shortage of females, little change has been implemented towards increasing female participation in the STEM fields (McCarthy, 2007). If more females were recruited into technology fields more diversity in the workplace would become a reality. With a more diverse population, possibilities will be achieved in technological careers.

Assumptions of the Study

This study and its conclusion were subject to the following assumptions:

1. Participants completed the survey instrument honestly and without bias.
2. Participants completed all activities of the camp.
3. Participants who attended Cheering in the Classroom had an interest in cheerleading or dance.

Limitations of the Study

This study had the following limitations:

1. Both camps were limited to the participants who attend the summer camps.
2. The sample size was limited to the participants in the Cheering in the Classroom camp and TEAM camp.
3. TEAM camp participants consisted of only 8^{th} and 9^{th} graders.
4. Cheering in the Classroom camp consisted of 9^{th}, 10^{th}, 11^{th} and 12^{th} graders

Review of Literature

The U.S. Department of Labor (2005) predicts employment in professional, scientific, and technical services will grow by 28.4% and add 1.9 million new jobs by 2014. Employment in computer systems design and related services will grow by 39.5%, and add almost one-fourth of all new jobs in professional, scientific, and technical services (U.S. Department of Labor Bureau of Labor Statistics, 2005).

> An insufficient number of Americans obtain degrees in science, technology, engineering, and mathematics compared to the nation's economic competitors. More Americans need to be encouraged to pursue such fields so that the United States has the workforce necessary to generate the new ideas that led to the new industries. Individuals who obtain STEM degrees are smart people who can work in a variety of occupations beyond those traditionally assumed for those who earn such degrees (Stine, 2008, p.18).

Even with this documented future need for a technical workforce, undergraduate engineering and technology programs were still unable to attract females to their program (Shanahan, 2006).

In an effort to increase females in technology, myths concerning females and technical careers need to be banished, such as the myth "that girls cannot do math or science at a high level of success" (Kleinfeld, 1998, p. 1). According to Silverman and Prichard (1996) female students who choose STEM courses on purpose (as opposed to being assigned into a class by counselors due to a lack of other interests by the student or openings in other classes) were often in the top 10% of the class. In addition, it was largely accepted that Technology and Vocational Education (TVE) can equip women for the job market or self-employment, thereby increasing their self-reliance and self-confidence besides inculcating in them the capacity to make vital decisions about themselves and a society at large (Mishra, Khanna, & Shrivastava, 2000). However, females want to feel accepted into their culture and have an image of how females should act in order to be welcomed fully into society and oftentimes a technical career isn't part of this "accepted image"

(Kandaswamy, 2003; Avsievich 2001). Mindock (2006) agreed, children discover gender stereotypes for "observational learning" by watching, practicing and internalizing adults' behaviors (McCarthy, 2007). While girls need to overcome these cultural biases in all parts of American education, the areas most resistant to change in the sense of gender equity are STEM and technology education (McCarthy).

Efforts need to be made to increase female awareness/interest in technical careers. This needs to begin at an early age. For instance, females in middle school are not making the connection between what they are learning in technology education classrooms to how they can apply it in technological careers (Silverman & Pritchard, 2003). It is the responsibility of the career counseling and middle school technology education teachers to focus on relaying information about nontraditional occupations that relate to the work they do in technology classes (Wisconson, 2000). Because of this disconnect at an early age, there are a disproportionately high number of girls who are losing interest in STEM courses during their middle school and high school years (NSF, 2002).

Opportunities for women in engineering and technology seem endless (Shanahan, 2006). Shanahan suggested that the secret to increasing females in technology was not to "fix" the girls, but make the technology classroom and profession more appealing to and welcoming of girls. Rather than trying to replicate the approaches and interest of the small number of girls successful in technology to a larger group, the secret was to make the environment one that the larger group wishes to join.

Current Programs and Publications to Recruit and Retain

McCarthy (2007) stated that there have been hundreds of programs attempting to redirect female interest to the STEM fields; however, these programs have had little success, and the amount of female involvement has leveled off. The NSF highlighted 209 funded grants for projects addressing gender issues in its publication of, *New Formulas for America's Workforce: Girls in Science and Engineering* (NSF, 2003a). They have support programs for mentoring, current teachers and classes that "feed and not weed" female students into the technology fields. A majority of the programs featured in this report suggests that all programs are paired up with a mentoring program. Several programs have proven successful when pairing students up with a more experienced student, professor or professional. A community-based mentoring program written by Linda H. Mantel found that 94% of her students intended to get married and 77% of them intended to have children. It was because of these goals that there was a need for role models to show students the possibility of completing their personal goals along with their professional goals (NSF, 2003a).

Pamela E. Jansma from the University of Arkansas found an activity for undergraduate and graduated students with the broadest impact thus far (NSF, 2003a). Her activities included weekend field trips, 10-day field experiences, mentoring ladders, and scholarly seminars. The largest impact was from the mentoring speakers. The speakers were invited by the current students, creating a greater interest from both sides. Luncheons and receptions were paired with each mentoring speaker and were very well attended and beneficial to the students (NSF, 2003a).

Research publications, including the *American Association of University Women Educational Foundation's Tech Savvy* (American Association of University Women

Educational Foundation, 2000) and *Women at Work* (Women at Work, 2003), have also recognized the gender gap and documented the troubling shortage of females preparing to work in these fields (Dyer, 2004). In response to this shortage governmental and nongovernmental organizations have created a wide array of programs and strategies (Dyer). There were 123 technology projects, which focused on computer development and application along with career information. Fifty-seven of the projects offered were intended for females only. The goals were to increase awareness and academics.

The American Association of University Women Educational Foundation and NSF are two of the largest foundations that are addressing gender diversity in the STEM fields (Dyer, 2004). These foundations together donated nearly $90 million between 1993 and 2001. The funds were distributed to 416 projects targeted to increasing the participation of females in STEM fields.

In summary, the gender gap in engineering and technology fields has been well documented. Gender equity in engineering and technology is an issue that continues to persist at the national level. From the studies presented, the accomplishments and discouragements of females entering into technology careers are evident. The literature indicates that females are needed in technical fields of study. With all of the previous deterrents females have faced in entering into the workforce, it is imperative to discover what attracts females to technical careers.

Methodology

This study was a descriptive study that used a Lykert-type survey instrument to collect data pertaining to participant~~’~~s’ perceptions of two different technology recruitment efforts. TEAM was a five-day summer camp that taught high school females about the career opportunities in technology. Information was relayed to participants through traditional activities (such as hands-on lab activities that were directly related to a career in technology), lectures, and through personal contact with current students; however, no attempt to capture personal interests (other than technology) was made in the camp. The Cheerleading in the Classroom camp had the same goal and used the same methods to relay information, but utilized cheerleading as a platform to explain the same technologies. For example, all lab activities not only had a direct correlation to technology, but also some aspect of cheerleading as well. The pilot four-day camp, Cheerleading in the Classroom, was the new recruitment camp for females offered by the College of Technology. This study examined the effectiveness of the four-day and five-day camps, specifically on the participant's knowledge and attitudes pertaining to careers in technology.

This study was based upon a previous study conducted at University of California Davis in California. It was a three year, NSF funded, pilot project that tried to improve the engineering climate for females in K-12. Efforts were acquired using outreach programs and research/mentorship opportunities for the high school students. The participants of this study completed a pre and post questionnaire to determine the significance of the attended workshop, luncheon, or day on campus. The data were collected and evaluated through qualitative and quantitative research. Part of the research found that when asked, "How much do you know about engineering?" students rated their self –knowledge as significantly higher after attending a "Day on Campus" (Darby & Bland, 1994).

This study has followed techniques and advice from the previous UC Davis study. During the opening session of camp, the participants completed a Lykert-type survey pertaining to their knowledge and interests in technology prior to any camp activities. Participants then completed the same questionnaire at the conclusion of camp. The survey was examined to determine if a difference was made in participant perceptions during the course of the camp.

Population and Sample

Each camp consisted of 7-18 high school females who attended one of the two technology camps. While no one was excluded from attending the camp, high school female cheerleaders were the target populations. For the TEAM camp, three hundred brochures were sent out to females in the Purdue University database who labeled herself as a female with an interest in technology. The 200 Cheerleading in the Classroom brochures were targeted more specifically to females who labeled herself with an interested in cheerleading or dance. Thirty packets accompanied by brochures were sent to Indiana and Illinois cheerleading coaches. Phone calls were made to schools within the 200-mile radius of Purdue University. Packets were sent out to the schools that answered their phones and provided a current address for a packet to be sent. Information was available online making both camps accessible to any interested student.

Data Collection

The survey was distributed to participants of two separate summer programs at Purdue University, TEAM, and Cheering in the Classroom. The data was collected through the use of a Likert-type survey instrument. An alphanumeric code was assigned to both the pre and post camp questionnaires to identify all participants. Numbers were assigned, replacing participant's names, to protect the identity and confidentiality of the participants.

Demographic information

Participants were first asked to include basic demographic information through thirteen questions. The demographic information provided was hometown and state, gender, year in school, favorite classes in school, plans for highest degree of education, plans to major in a technology field, knowledge of women working in a technical field, plans for their own future job along with **what it is**, and if they personally know of anyone or females in that specific field, the steps to take to achieve their dream job, who influences their decision, what influences their decision, does their mother do scientific or technical work, and does their father do scientific or technical work.

Pilot Activities

Participants were asked to participate in multiple activities that were grounded in the area of technology, but had a cheerleading theme. One or two representatives from the different majors within the College of Technology directed each of the activities. Eight different activities were created exclusively for the Cheering in the Classroom camp. In the area of computer and information technology, participants designed digital cheerleading routines via computer using motion capture software and technology. Photos were edited using photo editing software in the computer graphics technology area. Participants designed and programmed an animated cheerleading pyramid using and programming animation software. In electrical engineering technology participants designed and created a choreographed dance that was performed by robots. Participants were given the opportunity to explore the mechanics of sound waves and amplitude through mixing music in GarageBand in mechanical engineering technology. In aviation technology participants applied the concepts of physics to cheerleading as they analyzed physics behind many different cheerleading tosses and jumps. And finally, participants learned about supply chain management by building, shipping, and selling a cheer item.

Data Analysis

Surveys were distributed to twenty-five female participants who attended a summer camp. Eighteen of the 25 females were studied at the TEAM camp and the other seven females were studied at the Cheering in the Classroom camp. Three of the participants in TEAM camp were not included in the study due to absent Internal Review Board (IRB) consent from a parent or legal guardian. Twenty-five surveys were completed and deemed valuable information for the study.

State of residence of the participants

Participants were asked to indicate in which state they resided. The majority of participants in both camps were from the state of Indiana. Indiana represented 72% (n = 13) of the participants for the TEAM camp and 71% (n = 5) of the participants who attended Cheering in the Classroom camp. Other states represented in the TEAM camp included: Michigan (n = 2, 11%), Kentucky (n = 1, 6%), Ohio (n = 1, 6%), and California (n = 1, 1%). Illinois (n = 2, 29%) was the only other state represented during the Cheering in the Classroom camp. Complete demographics of the represented home states for both camps are graphically displayed in Table 1.

Table 1
Current home state of the participants of the survey

TEAM

State	n	%
Indiana	13	72%
Michigan	2	11%
Kentucky	1	6%
Ohio	1	6%
California	1	6%

Cheering in the Classroom

State	n	%
Indiana	5	71%
Illinois	2	29%

Participant's grade level

Participants were asked to indicate which grade level they would be entering during the fall. More than half (n = 12, 67%) of the TEAM participants were entering into 10th grade in the fall. Almost half (n = 3, 43%) of the Cheering in the Classroom participants were entering 9th grade in the fall. A complete breakdown of the participants' grade level for both camps can be found in Table 2.

Table 2
Participant's grade level

TEAM

Grade	n	%
8^{th}	1	6%
9^{th}	5	28%
10^{th}	12	67%

Cheering in the Classroom

Grade	n	%
6^{th}	1	14%
9^{th}	3	43%
10^{th}	1	14%
11^{th}	1	14%
12^{th}	1	14%

Technology and Career Perceptions

The second and third portions of the survey asked the participants to rank various statements on a Lykert-type scale. The second section asked participants to respond to questions regarding their personal perceptions of technology. The third section tested the participants' knowledge of the 13 majors represented in Purdue University's College of Technology. Responses on the Lykert-type scale ranged from one to four. One represented "not true"; two represented "somewhat true"; three represented "true"; and four represented "very true." When evaluating the data, the researcher assigned the original number of one to four to each response to collect the statistical data. Statistical data for each question was calculated to determine the statistical mean, standard deviation and T-score. The statistical information was then used to evaluate each camp, compare the two camps together, and determine the effectiveness of each camp compared to each other.

Research Question #1
Did attending the Cheering in the Classroom or TEAM camp affect participant's perceptions concerning technology?

Technology Perceptions

Participants responded to the following statements on the Lykert-type scale: "I like technology," "I would feel comfortable in a technology field," "I would enjoy a future in a technology field," "I think technology is interesting," and "I think technology holds a bright future for me." Neither camp documented a statistical difference when responding to the question "I like technology". Cheerleading in the Classroom showed a decrease in the statistical mean on the post-test for the statement, "I would feel comfortable in a technology field" (T = .2229) while TEAM showed a small increase. Although there was an increase in the T-score, neither camp had a T-score that was large enough to be proven statistically significant. The statement, "I would enjoy a future in a technology field" (T =.6), had a greater increase for Cheering in the Classroom but was not enough to be deemed statistically significant. Between both camps, two statements did prove to be statistically significant. The statements, "I think technology is interesting" (T = 2.0857) and "I think technology holds a bright future for me" (T = 1.8601), were statistically significant for Cheering in the Classroom. For a complete breakdown of all the statistical data, refer to Table 3.

Table 3
Perception Statements of Each Camp

Perception Statement	Camps	Pre-Survey			Post-Survey			T-score
		M	SD	N	M	SD	N	
I like technology	TEAM	3.1	0.68	18	3.1	0.76	18	0.0000
	Cheering	3.1	0.90	7	3.1	0.90	7	
I feel comfortable with technology	TEAM	2.8	0.62	18	3.0	0.77	18	0.2229
	Cheering	2.9	1.35	7	2.7	1.11	7	
I would enjoy a future in technology	TEAM	2.7	0.67	18	3.0	0.78	18	0.6
	Cheering	2.1	1.21	7	2.6	0.98	7	
I think technology is interesting	TEAM	3.1	0.68	18	3.2	0.62	18	2.0857
	Cheering	2.3	0.76	7	3.3	0.95	7	
I think technology holds a bright future for me	TEAM	2.5	0.79	18	2.5	0.85	18	1.8601
	Cheering	2.1	1.07	7	2.9	1.07	7	

Research Question #2

Did attending the Cheering in the Classroom or TEAM camp increase participant's awareness of various college majors within the academic discipline of technology?

Participant's awareness of various college majors

The participants were asked to identify their awareness of the various college majors within the academic discipline of technology using the Lykert-type scale. Responses on the survey ranged from one to four. One represented "I have never heard of it," two represented "I have heard of it," three represented "I know a little bit about it," and four represented "I know a lot about it."

Of the 13 majors, all of the statistical means increased on the post survey from the pre survey for both the TEAM and the Cheering in the Classroom camp. During the TEAM camp, four of the 13 majors had means with a larger increase than the Cheering in the Classroom post surveys. Those majors included: Aviation Management (T = 1.50), Aviation Technology (T = 1.56), Industrial Distribution (T = 1.47), and Organizational Leadership and Supervision (T = 1.51). For data to be deemed statistically significant, the T-score was required to be equal or greater than 1.740. None of the majors proved to be statistically significant.

During the Cheering in the Classroom camp, 9 of the 13 majors had means with a larger increase than the TEAM post surveys. Those majors included: Aviation Flight Technology (T = 1.3077), Building Construction Management (T = 1.382), Computer Graphics Technology (T = 1.0954), Computer and Information Technology (T = 1.4491), Electrical & Computer Engineering Technology (T = 1.1225), Industrial Technology (T = 1.3638), Engineering Technology Teacher Education (T = 1.1533), Manufacturing Engineering Technology (T = 1.1045), and Mechanical Engineering Technology (T = 1.2767). In order for the data to be deemed statistically significant, the T-score was required to be equal or greater than 1.740. As with TEAM, none of the majors proved to be statistically significant. For a complete breakdown of all the statistical data, refer to Table 4.

Table 4
Perception of Each Major

Technology Major	Camps	Pre-Survey			Post-Survey			T-score
		M	SD	N	M	SD	N	
Aviation Management	TEAM	1.8	0.86	18	3.0	0.34	18	1.5
	Cheering	1.7	1.11	7	2.7	0.76	7	
Aviation Technology	TEAM	2.1	0.94	18	2.9	0.54	18	1.5556
	Cheering	1.9	1.21	7	2.1	1.21	7	
Aviation Flight Technology	TEAM	2.2	0.94	18	3.1	0.42	18	1.3077
	Cheering	1.9	1.07	7	3.1	0.90	7	
Building Construction Management	TEAM	2.2	0.55	18	3.2	0.54	18	1.382
	Cheering	1.7	0.95	7	3.0	0.82	7	
Computer Graphics Technology	TEAM	2.7	0.91	18	3.1	0.58	18	1.0954
	Cheering	2.0	1.15	7	3.1	0.90	7	

Computer Information Technology	TEAM	2.6	0.92	18	3.1	0.54	18	1.4491
	Cheering	1.4	0.79	7	3.0	0.82	7	
Electrical Computer Engineering Technology	TEAM	2.4	1.04	18	2.9	0.64	18	1.1225
	Cheering	1.7	0.95	7	2.7	1.03	7	
Industrial Technology	TEAM	2.0	0.59	18	2.9	0.73	18	1.3638
	Cheering	1.6	1.13	7	2.8	0.57	7	
Industrial Distribution	TEAM	1.8	0.86	18	2.9	0.73	18	1.4697
	Cheering	1.6	1.13	7	2.4	0.98	7	
Engineering Technology Teacher Education	TEAM	2.2	0.73	18	2.9	0.96	18	1.1533
	Cheering	2.0	1.15	7	3.0	0.82	7	
Manufacturing Engineering Technology	TEAM	2.2	0.99	18	2.7	0.67	18	1.1045
	Cheering	1.7	0.76	7	2.7	0.76	7	
Mechanical Engineering Technology	TEAM	2.5	0.92	18	2.9	0.68	18	1.2767
	Cheering	1.6	1.13	7	2.9	0.69	7	
Organizational Leadership and Supervision	TEAM	2.1	1.11	18	3.2	0.81	18	1.5133
	Cheering	1.4	1.13	7	2.3	0.95	7	

Research Question # 3
Did attending the Cheering in the Classroom or TEAM camp have more of an influential effect on the participants?

After analyzing the data, two items from the survey were determined to be statistically significant in having a greater effect on the participants during their respective camp. The items included: “I think technology is interesting” (T-score = 2.086) and “I think technology holds a bright future for me” (T-score =1.86). Both of the questions were statistically significant in favor of Cheering in the Classroom. Therefore, the researcher found Cheering in the Classroom had a greater effect on the participants than the TEAM camp. For a complete breakdown of each question and the statistical data, refer to tables 3-20.

Summary, Conclusions, and Recommendations

Currently, there are several programs that are focused on mentoring high school, undergraduate, and graduate students in the STEM fields. The majority of these programs are focused on retention of females who are successful in a STEM area of interest. Nationally, America has recognized the need to recruit and educate females in various technology fields. Traditional methods of recruitment have been in place for several years now.

Cheering in the Classroom was a non-traditional recruitment method that engaged middle and high school students in technology activities without having a prior interest in a technology-based field. The goal of this camp was to have participants leave with a greater knowledge and interest in a technology field from their arrival at camp. Through unique activities, participants were given an opportunity to explore all available technology. In a non-threatening environment participants utilized hands-on activities to simulate future job possibilities.

The purpose of this study was to determine the effectiveness of applying a previously related interest/activity to technology concepts. Due to the uniqueness and originality of this camp, the TEAM camp was used as a control group. Cheering in the Classroom was unique in that it applied a cheerleading theme to all activities. These camps were chosen for this study because of their shared goal to educate and recruit females into pursuing a technology major.

Conclusions

Statistical results found both camps to have had an overall positive effect on the participants. Due to the various sample sizes for each camp, in order to be deemed statistically significant a large increase in the post data was required to be noted in this study. Statistically, Cheering in the Classroom was proven to have had a greater effect in increasing participants' positive technology perceptions and awareness. Participants' interest in technology increased significantly after attending the Cheering in the Classroom camp. Participants also believed that they had a brighter future in a technology field and were more interested in technology after attending the Cheering in the Classroom camp. From this, statistical data has proven that technology related to a previous/current interest area can help to increase female's perception of technology.

Cheering in the Classroom gave the participants a unique experience to explore the various technology-related majors. With the cheerleading related activities, participants were able to relate technology to their own personal interest. The connection between technology and cheerleading was clear to the participants. The correlation aided the learning of technology for the participants in Cheering in the Classroom.

Therefore it is recommended that additional recruitment initiatives that capitalize on participants personal interests be created and these initiatives be further studied.

With the time constraints of the study, a long-term observation was not possible. The researcher recommended a study should be conducted to measure how effective the camps are several months after their conclusion. It is important to observe the participants' perceptions during their high school, college, and professional careers. The ultimate goal of the technology camps was to encourage participants to pursue a professional career in a STEM field.

Due to the limitations of this study, it is recommended that the study be replicated with the following revisions:

1. The study should be replicated with closer to 30 participants attending both camps.
2. The study should be replicated multiple times to evaluate the consistency of the camp.
3. An additional longitudinal study should be conducted in which the participants are observed during the following school years to determine what academic courses are completed.
4. A longitudinal study should be conducted that tracks participants to determine if they matriculate into a technology major.
5. A longitudinal study should be conducted that tracks participants to determine if they matriculate into a technology career.

References

Acemoglu, D., Autor, D. H., & Lyle, D. (2004). Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Mid-century. *The Journal of Political Economy, 112*, 479.

Alice (2007). Retrieved January 8, 2008 from Web site: http://www.alice.org/.

American Association of University Women Educational Foundation. (2000). Tech-Savvy: Educating girls in the new computer age. Washington, DC.

Avsievich, N. (2001). *Gender Stereotypes, Family and School.* In the International Seminar about gender stereotypes in Pinsk, Belarus, in November. Retrieved April 4, 2007, from http://www.vitryssland.nu/gender.html

Best, J., & Kahn, J (1989) *Research in Education* (6th Edition). Englewood Cliffs, New Jersey: Prentice Hall.

Borg, W., & Gall, M. (1983). *Educational Research An Introduction.* New York: Longman Inc.

Coffey, L. C. (1909). *Lessons in corn*. [Schools of Illinois Circular 38]. Springfield, IL: Illinois State Journal Co.

Cumberland County Training Resource Center. (2007) Workforce Development Glossary Retrieved June 6, 2007, from www.trcme.com/Default.aspx?abid=80

Darby, J. & Bland, M.M. (1994). A Model Project to Improve the Climate for Women in Engineering. Washington, DC: Fund for the Improvement of Post secondary Education. (ERIC Document Reproduction Service No. ED 416 770)

Dyer, S. K. (2004). *Under the Microscope : A Decade of Gender Equity Projects in the Sciences.* Washington, DC: American Association of University Women Educational Foundation. (ERIC Document Reproduction Service No. ED 485720)

Foster, P. N. (1995a). The Founders of Industrial Arts in the US. Journal of Technology Education, 7(1). Retrieved April 12, 2007 from http://scholar.lib.vt.edu/ejournals/JTE/v7n1/foster.jte-v7n1.html

Foster, P. N. (1995b). Information Related to Lois Coffey Mossman. Retrieved April 12, 2007 from http://www.teched.ccsu.edu/foster/mossman/index.htm.

GarageBand (2008) Retrieved January 8,2008 from Web site: http://www.apple.com/ilife/garageband/.

Gemmill, P. (1979). Industrial arts laboratory facilities-Past, present, and future. In G. E. Martin (Ed.) *Industrial arts education: Retrospect, prospect* (pp. 86-112.) Bloomington, IL: McKnight & McKnight.

Goldin, Claudia. (1991). "The Role of World War II in the Rise of Women's Employment." A.E.R. 81 (September): 741-56.

Grant, L., & Ward. K.(1992). *Mentoring, Gender, and Publication Among Social,Natural, and Physical Scientists.* Washington, D.C.: Office of Educational Research and Improvement, Department of Education.

Hartman Strom, S. & Wood, L. (1995). *What did you do in the War, Gramma: Women and World War II.* Retrieved February 18, 2006, from www.stg.brown.edu/projects/WWII_Women/WomenInWWII.html

Hartsock, N. (1987). 'The feminist standpoint: Developing the ground for a specifically feminist historical materialism', in Harding, S. (ed.). Feminism and Methodology. MiltonKeynes: Open University Press

Haynie, III, W. (1999, Spring). Cross-Gender Interaction in Technology Education: A Survey. *Journal of Technology Education 10, 2.* Retrieved October 18, 2006, from http://www.ece.uncc.edu/succeed/journals/PDF-files/jte-07.pdf

Haynie, W.J. III. (2003, Fall). Gender Issues in Technology Education: A Quasi-Ethnographic Interview Approach. *Journal of Technology Education,* 15, 15. Retrieved October 8, 2006, from Virginia Tech Digital Library and Archives database.

Kandaswamy, D. (2003). *Talibanism in Technology; Seven reasons why women in technology remain invisible.* Retrieved April 20, 2007, from http://www.dqindia.com/content/special/103022602.asp

Kleinfeld, J. (1998).*The Myth That Schools Shortchange Girls: Social Science in the Service of Deception*. Washington DC: The Women's Freedom Network. Retrieved April 13, 2007, http://www.uaf.edu/northern/schools/myth.html

McCall, C. (2001). An empirical examination of the Likert-type scale: some assumptions, development an cautions. Paper presented at the annual meeting of the CERA conference, South Lake Tahoe, CA.

McCarthy, R,R. (2007) Unexpected Transitions; Moving Beyond Cultural Barriers: Successful Strategies of Female Technology Education Teachers. Unpublished Doctoral Dissertation, University of Massachusetts, Amherst.

Merriam-Webster. (2005). *Merriam-Webster OnLine Search.* Retrieved March 4, 2008, from Merriam-Webster Online, Web site: http://www.merriam-webster.com/

Metz, S. (2006) *Why Are There Still Underrepresented Groups in Engineering: Understanding the Issues*. Project Lead the Way STI Preparation Session, presented on April 7

Mishra, A. Khanna, P. & Shrivastava, N. (2000). Promoting Equal Access of Girls/Women to Technical and Vocational Education. Bhopal, India: Pandit Sunderlal Sharma Central Institute of Vocational Eduaction. (ERIC Document Reproduction Service No. ED 454367)

Morris, L. K., (2002). Women in Information Technology Literature Review: Recruitment, Retention, and Persistence Factors. Jacksonville, Florida: Rosanne R. Hartwell Women's Center (ERIC Document Reproduction Service No. ED 477715)

National Science Foundation. (2002). *Undergraduate enrollment in engineering programs, by sex, race/ethnicity, and citizenship: 1994–2002.* Women, Minorities, and Persons with Disabilities in Science and Engineering. http://www.nsf.gov/sbe/srs/wmpd/tables/tabb-9.xls

National Science Foundation. (2003a). *New Formulas for America's Workforce: Girls in Science and Engineering.* Sage Publications. Retrieved April 1, 2007, from http://scx.sagepub.com/cgi/content/refs/27/1/27

National Science Foundation, (2003b). The Science And Engineering Workforce: *Realizing America's Potential.* Retrieved April 14, 2007, from *http://www.nsf.gov/nsb/documents/2003/nsb0369/nsb0369.pdf*

On the ground floor. (1907). *The Western Courier, 5*(16), 123.

Oregon State University Extension Service. (2005). *Middle Childhood and Adolescent Development.* Retrieved May 20, 2007 from, http://www.focusas.com/Adolescence.htm#MIDDLE%20CHILDHOOD%20(A'ges%208-11). 159

Purdue University. (2007, June) Cheering in the Classroom. Retrieved June 6, 2007, from College of Technology website:http://www.tech.purdue.edu/student_life/diversity/cheering_in_the_classroom.cfm

Purdue University. (2007, June) Technology Expanding All Minds. Retrieved June 6, 2007, from College of Technology website: http://www.tech.purdue.edu/student_life/diversity/TEAMSummerCamp.cfm

Sabbatini, R. (1997). *Are There Differences between the Brains of Males and Females?* Retrieved May 22, 2007, form Brain and Mind Web site: http://www.cerebromente.org.br/n11/mente/eisntein/cerebro-homens.html

Sciannamea, M. (1997) Gender equity thrives in the information technology industry. *Electronic Design*, 45,211-212.

Shanahan, B. (2006). The Secrets to increasing Females in Technology. *The Technology Teacher, 66*(2), 22-24.

Siann, G. (1997). 'We can, we don't want to: Factors influencing women's participation in computing'. In Lander, R. and Adam, A. (eds.), *Women in Computing*. Exeter: Intellect Books

Silverman, S. (1999). *Gender equity and school-to-career. A guide to strengthening the links to nontraditional careers*. Hartford. CO: Connecticut Women's Education and Legal Fund. (ERIC Document Reproduction Service No. ED 439291)

Silverman, S. & Pritchard, A. (1996). Building Their Future: Girls and Technology Education in Connecticut. *Journal of Technology Education, 7*(2). Spring 1996. http://scholar.lib.vt.edu/ejournals/JTE/v7n2/silverman.jte-v7n2.html.

Smith, L. B. (2000). The socialization of females with regard to a technology-related cararee. MERIDIAN: A MIDDLE SCHOOL COMPUTER TECHNOLOGIES JOURNAL 3, 2. http://www.ncsu.edu/meridian/sum2000/career/

Society of Women Engineers (2007). Retrieved June 8, 2007 from Web site: http://www.swe.org/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=8&ssSourceNodeId=14

Stine,D. (2008). *CRS Report for Congress*. Congressional Research Service. Washington, DC.

Thomas, S. J. (1988). *Out of the kitchen: The transformation of Teachers College, Columbia University, 1913-1933*. Paper presented at the Annual Meeting of the Association for the Study of Higher Education (St. Louis, November 3-6). EDRS ED 303 072 (HE 022 092).

U.S. Department of Labor Bureau of Labor Statistics. (2005). *Tomorrow's Jobs*. Retrieved February 6, 2007 from Web site: http://www.bls.gov/oco/oco2003.htm

Western Illinois State Normal School. (1910). *Sequel*. [Yearbook.]

Wikipedia. (2008). Adobe Photoshop. Retrieved January 28, 2008, from *Wikipedia, the free encyclopedia* Web site: http://en.wikipedia.org/wiki/Adobe_Photoshop

Wisconsin Department of Public Instruction. (2000). *Preparing Young Women For Work And Citizenship in A Technological Society.* Retrieved April 20, 2007, from http://64.233.161.104/search?q=cache:FBYt7G613IEJ: dpi.wi.gov/cte/pdf/tblib.pdf+Wisconsin+(Welty+and+Puck,+2000&hl=en&client=firefox-a.

Witts, S. (1997). Parental influence on children's socialization to gender roles. *Adolescence*, 32(126),253-259.

Weber, K. & Custer, R. (2005, Spring). Gender-based Preferences toward Technology Education Content, Activities and Instructional Methods. *Journal of Technology Education,* 16(2), 55-78.

Welty, K., & Puck, B. (2001). *Modeling Athena: Preparing young women for work and citizenship in a technology society*. Madison; Wisconsin Department of Public Instruction, from http://dpi.state.wi.us/cte/pdf/tblib.pdf

Unknown (2007). Women Increasingly Likely To Be Leaders in U.S. Higher Education. *News Blaze*. Retrieved February 29, 2007, from http://newsblaze.com/story/20070221125322tsop.nb/newsblaze/TOPSTORY/Top-Stories.html.

Zuga, K. (1999). Addressing Women's Ways of Knowing to Improve the Technology Education Environment for All Students. *Journal of Technology Education, 10*(2), Spring 1999. Retrieved May 15, 2007, from http://scholar.lib.vt.edu/ejournals/JTE/v10n2/zuga.html

Identifying Perceived Professional Development Needs of Idaho Secondary CTE Teachers: Program Management Needs of Skilled and Technical Science Teachers

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Abstract

The purpose of this study was to examine the perceived training needs of Idaho secondary skilled and technical science teachers for a set of non-instructional competencies specifically associated with duties related to program management. The population of this study consisted of skilled and technical science teachers employed by Idaho secondary schools for the 2008-09 academic year (N=181). Sixty percent (n=109) of the 181 teachers participated in the study. The findings indicated that the perceived in-service training areas for the program management construct, as identified by a mean weighted discrepancy score (MWDS) ranking, to be grant writing and funding opportunities, developing curriculum-based school-to-work and/or school-to-career activities, and establishing and organizing co-op/internships. Individuals involved with teacher preparation and in-service training can use the findings of this study to inform the development of pre-service curriculum and in-service educational offerings.

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Introduction

Career and technical education (CTE) teachers must stay current with the best professional practices and content area industry needs. Wash, Lovedahl, and Paige (2000) argued that for beneficial change to occur in the classroom, "…teachers need access to information concerning current practices and trends" (p. 45). According to Boser and Daugherty (1994), advancing the educational profession forward requires providing teachers with "…updated information on curriculum, methodology, and technology to allow them to make philosophical and programmatic changes that augment technology education" (p. 4). Greenan, Mustapha, Wu, and Ncube (1998) identified factors that motivate vocational teachers to improve their programs as – "…caring for students, concern for professional growth, and a desire to keep programs current with changing technologies" (p. 11). Joerger (2002) emphasized the need for appropriate and timely pre-service and in-service activities for CTE teachers to ensure that they are properly equipped to contend with changing conditions in CTE education. Lambeth, Elliot, and Joerger (2008) identified professional development of teachers as part of the national CTE research agenda. While researchers can agree that appropriate pre-service and in-service training must be provided to teachers, it is much more difficult to identify the training that is most appropriate and most needed. This study sought to identify Idaho's skilled and technical science teachers' perceived professional development needs as they pertain to program management.

Conceptual Framework

As the nature of the global economy changes, secondary skilled and technical science teachers face the challenge of providing learning experiences that prepare their students to enter the work force or to pursue additional educational opportunities. Aligned with industry, curriculum areas for skilled and technical science include automotive repair, building construction, cabinetry and furniture making, electronics technology, information systems technology, media technologies, and small engine repair. In order to prepare students for the needs of industry, skilled and technical science teachers must continually work to stay in the forefront of good teaching practices in regard to pedagogy and technology. They must also have the skills and knowledge necessary to manage their programs. To meet this demand, these teachers need annual in-service training opportunities from both educational institutions and industry. It is through in-service training that skilled and technical science teachers expand their knowledge and improve their pedagogical and program management skills.

The professional development of teachers is an important aspect of the national CTE research agenda (Lambeth, Elliot, & Joerger, 2008). In-service opportunities are often orchestrated by teacher educators and state career and technical education staff to meet the needs of teachers (Barrick, Ladewig, & Hedges, 1983). One proven method of identifying CTE pre-service and in-service needs utilizes a descriptive survey based on the Borich Needs Assessment Model (Dobbins & Camp, 2000; Garton & Chung, 1996; Joerger, 2002; Layfield & Dobbins, 2002; Ricketts, Duncan, & Peake, 2006). Most researchers use a modified version of the Borich model to evaluate the "perceived level of importance" and "perceived level of competence" of teachers pertaining to professional competencies identified by research and related to the issues of their respective states. In 1997, Garton and Chung used a modified version of the Borich Needs Assessment Model and a quadrant analysis to survey the in-service needs of beginning agriculture teachers.

While Garton and Chung (1997) utilized a quadrant analysis, Edwards and Briers (1999) sought to compare the ranking of in-service needs based on a mean weighted discrepancy score (MWDS), i.e., the Borich model. Consequently, they determined that the discrepancy method, like the Borich model or a version of it, is more effective than a direct assessment. Edwards and Briers' finding informed the decision to use an instrument modeled after the Borich Needs Assessment Model to achieve the purposes of this study.

Previous professional development needs assessment research has been conducted primarily on beginning teachers and in agricultural education (Duncan, Ricketts, Peake, & Uesseler, 2006; Edwards & Briers, 1999; Garton & Chung, 1996, 1997; Heath, Dimock, Adams, & Zuhn, 1999; Joerger, 2002; Layfield & Dobbins, 2002; Mundt & Connors, 1999). Garton and Chung (1996 & 1997) found completing reports for local/state administrators, motivating students to learn, preparing FFA degree applications, and developing an effective public relations program to be the in-service constructs with the highest needs among beginning agricultural instructors. Mundt and Connors (1999) found classroom management/student discipline, time/organizational management, and managing the activities of the FFA chapter to be constructs beginning agricultural teachers identified as the most pressing challenges. Edwards and Briers (1999) found the highest ranked in-service needs to be assisting students in preparing for and succeeding in FFA degree and award programs; using the Internet as a teaching tool; balancing quality time among different life roles such as teacher, spouse, or parent; and using support groups to publicize the program. Maintaining the usefulness of an advisory committee; utilizing an advisory committee to promote the local agriculture and FFA programs; the ability to use the local advisory committee to acquire resources to sustain the local program chapter; and utilizing advisory committee members as resources for classroom, laboratory, SAE, and FFA activities were identified by Joerger (2002) as the highest in-service needs in his study of beginning agricultural education teachers.

Several agricultural education studies have sought to determine the in-service needs of experienced as well as beginning teachers. Layfield and Dobbins (2002) identified using computers in classroom teaching; preparing FFA degree applications; preparing FFA proficiency award applications; using multimedia equipment in teaching; and teaching recordkeeping skills as the most important in-service needs. They also identified the most important in-service needs of beginning agricultural education teachers to be utilizing a local advisory committee; developing local adult education programs; organizing fund-raising activities for the local FFA chapter; preparing agricultural/FFA contest teams; and developing supervised agricultural educational opportunities for students (Layfield & Dobbins, 2002). Duncan, Ricketts, Peake, and Uesseler (2006) identified the program management in-service needs of agricultural education teachers as being: the need for assistance with advising students who have an interest in post-secondary education, preparing various FFA applications, and developing an effective public relations program.

Few studies have been conducted to determine teacher in-service needs in CTE content areas other than agricultural education. Heath-Camp and Camp (1990) identified three areas of difficulty for beginning teachers: system-related problems such as inadequate orientation, equipment, and supplies; student-related problems such as lack of motivation and undesirable behavior; and personal struggles with self-confidence, time management, and organizational skills. Lu and Miller (2002) compared instructional technology in-service needs of teachers from Ohio with their counterparts in Taiwan whose highest rated needs were protecting computers from viruses and effectively using desktop video conferencing and tele-teaching technologies for distance learning (Lu & Miller, 2002).

Purpose and Objectives

The purpose of this study was to determine Idaho's skilled and technical science teachers' perceived levels of importance and competence as they relate to specific competencies, both for beginning and veteran teachers, and use that information to determine the perceived pre-service and in-service needs of this population. More specifically, the following objectives guided this study:

1. Determine the demographic characteristics and educational background of Idaho skilled and technical science teachers;
2. Describe Idaho skilled and technical science teachers' perceived importance of specific areas of program management;
3. Describe Idaho skilled and technical science teachers' perceived competence in specific areas of program management; and
4. Determine perceived professional development needs of Idaho skilled and technical science teachers in the specific area of program management.

Procedures

This study is part of a larger project investigating the perceived professional development needs of Idaho CTE teachers. Results have been separated by program area and construct categories. Specifically, this portion of the project focused on skilled and technical science teachers' perceived program management in-service needs. Program areas other than skilled and technical sciences were business and marketing, family and consumer sciences, health occupations, and technology education. The construct categories determined through a review of published research were teaching and learning and program management (Duncan, Peake, Rickets, & Uesseler, 2006).

A descriptive research design with a survey method was used. Data was collected from skilled and technical science teachers employed in a rural northwest state which described their perceived level of importance and competence across a variety of program management tasks and duties. Skilled and technical science encompasses the following content areas: automated manufacturing, automotive technology, building construction, cabinet and furniture making, collision repair, computer aided design (drafting), diesel technology, electronics technology, environmental science, home technology integration, industrial mechanics, law enforcement, masonry, media technology, precision machining, small engine repair, and welding.

The 59-item survey instrument was developed and adapted from previous research on agricultural teachers by Duncan, Peake, Rickets, and Uesseler (2006). The 2006 Duncan et al. instrument was a modified version of the *Minnesota Beginning Agricultural Education Teacher In-service Programming Needs Assessment* (Joerger, 2002). The Joerger (2002) instrument was modeled after Garton and Chung's (1996) instrument which was based on the Borich Needs Assessment Model (Borich, 1980). Twenty-four of the items were specific to program management (Table 1).

Table 1

Program Management Survey Items

Grant writing and funding opportunities
Career Clusters and Programs of Study / Pathways
Completing reports for local and state agencies
Conducting an adult program
Conducting needs assessments to determine Programs of Study / Pathways
Conducting parent/teacher conferences
Coordinating activities with local organizations/agencies
Determining CTE program content for specific courses
Develop and maintain required safety standards (State and Federal/OSHA standards)
Developing an effective public relations program
Developing curriculum-based School-to-Work and/or School-to-Career activities
Developing relations with fellow teachers and administrators
Establishing and using a program advisory committee
Establishing and organizing co-op/internships
Evaluating a CTE program
Fundraising for Career-Technical Student Organizations
Identifying appropriate course textbooks, references, and materials
Integrating CTSO activities into the regular classroom
Issues involved with traveling with students
Planning and conducting student field trips
Program related trends and current issues
Providing guidance and career exploration activities to students
Recruiting/promoting student involvement with CTSOs
Understanding federal (Perkins), state, and local funding

A panel of experts; consisting of faculty from the University of Idaho, University of Georgia, an Arizona CTE teacher, and four Idaho pre-service CTE teachers; evaluated the instrument for face, content, and construct validity. The reliability of the instrument was assessed through an analysis of the collected data. Reliability coefficient alphas were calculated for the items on both "Importance" ratings (α = .915) and "Competence" ratings (α = .917). The results indicated an instrument with a high degree of internal consistency. The data collected from this process, along with further review and analysis by the panel of experts, refined the instrument into its final form.

Idaho is a rural state which ranks nationally in the top 15 for land area, but in the bottom 15 for population. Agriculture and natural resources comprise the largest portion of the state's economy. However, leading corporations that manufacture technology such as Hewlett Packard and Micron Technology have operations in the most densely populated part of the state. Due to the state's expanse and remoteness, Idaho's educational system faces challenges regarding the quality of opportunities for all students. Examples of these challenges are providing a quality teacher for every classroom and providing students with access to technological advances.

The population for this study consisted of skilled and technical science teachers employed in Idaho for the 2008-09 school year (N=181). The instrument was administered to the population in May and June of 2009 through an online survey using procedures suggested by Dillman (2007). An initial invitation to participate was sent via e-mail to skilled and technical science teachers identified by the Idaho Division of Professional-Technical Education. Follow-up prompts for participation were delivered at two and four week intervals. In all, 109 (60.2%) skilled and technical science teachers completed the survey instrument.

Collected data were analyzed using Excel™ and the Statistical Package for the Social Sciences (SPSS) software. The importance and competence scores were used to calculate the teacher preparation and in-service needs by calculating a mean weighted discrepancy score (MWDS) for each item. The MWDS score was calculated by subtracting the competency score from the importance score, multiplying that number by the mean importance rating of the item, and then calculating the average of these values across cases (Borich, 1980; Joerger, 2002).

Non-response bias was of concern and examined by the researchers. Analysis of non-response bias is important in determining if a sample is representative of the population from which it was drawn. Miller and Smith (1983) determined that non-respondents are similar to those late in responding to surveys. In a review of research literature spanning ten years, Lindner, Murphy, and Briers (2001) concluded that "both early/late comparison and follow-up with non-respondents are defensible and generally accepted procedures for handling non-response error as a threat to external validity of research findings" (p. 51). Radhakrishna and Doamekpor (2008) indicated that if no significant difference is found between early and late respondents, then the findings from the sample may be representative of the population. For this study, non-response bias was evaluated by comparing the average importance and competence ratings between early respondents ($n = 56$) to late respondents ($n = 16$) through the use of an independent samples t-test. No statistically significant difference was found in the importance ratings between early respondents ($M = 3.99$, $SD = .57$) and late respondents ($M = 4.18$, $SD = .59$) ($t(70) = -1.112$, $p > .05$). The results of the independent samples t-test comparing competence ratings between early responders ($M = 3.46$, $SD = .66$) and late responders ($M = 3.64$, $SD = .49$) found no statistical difference between groups (t(70) = -1.048, p > .05). Based on these findings, the sample data was determined to be representative of the population from which it was drawn.

Findings

Objective One: *Determine the demographic characteristics and educational background of Idaho skilled and technical science teachers*

As indicated in Table 2, almost half of the skilled and technical science teachers who responded were from the traditional trade and industry content area (*n* = 53, *f* = 48.6). Close to a quarter of the respondents identified themselves in the trade and industry media content area (*n* = 26, *f* = 23.9), and another quarter identified themselves in the trade and industry information systems content area (*n* = 26, *f* = 23.9). Teachers who identified themselves as being in the trades and industry electronics group had the lowest number of respondents (*n* = 4, *f* = 3.6). The vast majority of respondents were male (*n* = 87, *f* = 79.8) and married (*n* = 89, *f* = 81.7). Teachers age 45 to 54 (*n* = 33, *f* = 30.3) and 55 to 64 (*n* = 33, *f* = 30.3) made up the largest age groups, with the same number of teachers in each. The 35 to 44 group was the next largest age group (*n* = 27, *f* = 24.8). Most of the respondents either had a high school diploma (*n* = 36, *f* = 33.0) or a master's degree (*n* = 36, *f* = 33.0). Teaching experience was diverse. Teachers with 11 to 20 years of experience represented the largest category (*n* = 31, *f* = 28.4). A large majority of teachers received training through the Idaho occupational certification process (*n* = 81, *f* = 74.3), while a little more than 50% of the teachers received teacher training through a traditional undergraduate degree program (*n* = 56, *f* = 51.4). It should be noted that teachers were given the opportunity to indicate more than one method of teacher training.

Table 2
Demographic Characteristics of Idaho Skilled and Technical Science Teachers

		n	%
Content Area:	Trade and Industry Traditional	53	48.6
	Trade and Industry Media	26	23.9
	Trade and Industry Information Systems	26	23.9
	Trade and Industry Electronics	4	3.6
	All Groups	109	100
Gender:	Female	22	20.2
	Male	87	79.8
Married Status:	Married	89	81.7
	Single	18	16.5
	Not Indicated	2	1.8
Age	<= 25	1	0.9
	25 to 34	13	11.9
	35 to 44	27	24.8
	45 to 54	33	30.3
	55 to 64	33	30.3
	>= 65	2	1.8
Education	High School Diploma	36	33.0
	2-year (Associate)	4	3.7

	4-year (Bachelor)	2	1.8
	Masters degree	36	33.0
	Specialist	4	3.7
	Doctorate	2	1.8
Teaching Experience	0 (just completed teacher training)	1	0.9
	1-2 years	17	15.6
	3-5 years	19	17.4
	6-10	23	21.1
	11-20	31	28.4
	>= 20	17	15.6
	Not Indicated	1	0.9
Training[1]	Traditional Undergraduate University Program	56	51.4
	Graduate Certification beyond Bachelors degree	31	28.4
	Combined Undergraduate and Graduate Program	27	24.8
	Substitute Teaching Leading to Full-time Teaching Position	5	4.6
	Occupational Certification (work experience plus course work)	81	74.3
	Alternative Certification (ABCTE[2], Peace Corps, etc.)	3	2.8
	No Formal Teacher Training	20	18.3

Note. Trade and Industry Traditional includes: automated manufacturing, automotive technology, building construction, cabinet and furniture making, collision repair, computer aided design (drafting), diesel technology, environmental science, home technology integration, industrial mechanics, law

enforcement, masonry, precision machining, small engine repair, and welding.
[1]Survey allowed participants to select all the listed options they felt applied, thus, overall total count exceeds participation count.
[2]American Board for Certification of Teacher Excellence.

Objective Two: Identify Idaho skilled and technical science teachers' perceived importance of specific areas of program management

Teachers were asked to rate 24 program management competency statements using the following response scale: Not Important (*M* = 1.0-1.49), Of Little Importance (*M* = 1.5-2.49), Somewhat Important (*M* = 2.5-3.49), Important (*M* = 3.5-4.49), and Very Important (*M* = 4.5-5.0). As reported in Table 3, Idaho skilled and technical science teachers viewed no competencies as "very important," 23 competencies as "important," and one competency (conducting an adult program) as "somewhat important". The top five competencies with the highest means were "Providing guidance and career exploration activities to students" (*M* = 4.42, *SD* = 0.69), "Developing relations with fellow teachers and administrators" (*M* = 4.42, *SD* = 0.73), "Develop and maintain required safety standards (State and Federal/OSHA standards)" (*M* = 4.32, *SD* = 1.04), "Identifying appropriate course textbooks, references, and materials" (*M* = 4.31, *SD* = 0.79), and "Program related trends & current issues" (*M* = 4.30, *SD* = 0.69).

Table 3

Importance Ratings of Program Management Construct Items for Skilled and Technical Science Teachers (n=109)

Topic	*M* [1]	*SD*
Providing guidance and career exploration activities to students	4.42	0.69
Developing relations with fellow teachers and administrators	4.42	0.73
Develop and maintain required safety standards (State and Federal/OSHA standards)	4.32	1.04
Identifying appropriate course textbooks, references, and materials	4.31	0.79
Program related trends and current issues	4.30	0.69
Determining PTE program content for specific courses	4.19	0.88
Evaluating a PTE program	4.17	0.86
Establishing and using a program advisory committee	4.16	0.92
Grant writing and funding opportunities	4.16	1.00
Developing an effective public relations program	4.16	1.02
Developing curriculum-based School-to-Work and/or School-to-Career activities	4.14	0.92
Understanding federal (Perkins), state, and local funding	4.11	0.89
Coordinating activities with local organizations/agencies	4.06	0.95
Establishing and organizing co-op/internships	4.03	0.89
Conducting parent/teacher conferences	3.94	1.13
Issues involved with traveling with students	3.88	1.13

Recruiting/promoting student involvement with PTSOs	3.83	1.09
Planning and conducting student field trips	3.69	1.01
Conducting needs assessments to determine Programs of Study / Pathways	3.63	1.08
Completing reports for local and state agencies	3.62	1.25
Career Clusters & Programs of Study / Pathways	3.60	1.05
Integrating CTSO activities into the regular classroom	3.60	1.12
Fundraising for CTSOs	3.57	1.19
Conducting an adult program	2.93	1.30

[1]Response Scale of 1=Not Important, 2=Little Importance, 3=Somewhat Important, 4=Important, 5=Very Important.

Objective Three: Identify Idaho skilled and technical science teachers' perceived competence in specific areas of program management

Teachers were asked to rate the same 24 program management competency statements using the following response scale: Not Competent (*M* = 1.0-1.49), Little Competence (*M* = 1.5-2.49), Somewhat Competent (*M* = 2.5-3.49), Competent (*M* = 3.5-4.49), and Very Competent (*M* = 4.5-5.0). As reported in Table 4, teachers perceived that they were "competent" in 11 of the 24 statements, and "somewhat competent" in the remaining 13 statements. The five highest perceived competence ratings were "Developing relations with fellow teachers and administrators" (*M* = 4.09, *SD* = 0.80), "Identifying appropriate course textbooks, references, and materials" (*M* = 3.93, *SD* = 0.87), "Conducting parent/teacher conferences" (*M* = 3.92, *SD* = 1.04), "Determining PTE program content for specific courses" (*M* = 3.88, *SD* = 0.81), and “Develop and maintain required safety standards (State and Federal/OSHA standards)” (*M* = 3.85, *SD* = 1.06).

Table 4

Perceived Competence Ratings of Program Management Construct Items for Skilled and Technical Science Teachers (n=109)

Topic	*M*[1]	*SD*
Developing relations with fellow teachers and administrators	4.09	0.80
Identifying appropriate course textbooks, references, and materials	3.93	0.87
Conducting parent/teacher conference	3.92	1.04
Determining PTE program content for specific courses	3.88	0.81
Develop and maintain required safety standards (State and Federal/OSHA standards)	3.85	1.06
Providing guidance and career exploration activities to students	3.74	0.90
Establishing and using a program advisory committee	3.71	1.09
Evaluating a PTE program	3.71	0.90
Planning and conducting student field trips	3.68	1.04
Program related trends and current issues	3.67	0.88
Completing reports for local and state agencies	3.54	1.13
Career Clusters and Programs of Study / Pathways	3.46	0.90
Coordinating activities with local organizations/agencies	3.44	1.05

Developing an effective public relations program	3.40	1.07
Understanding federal (Perkins), state, and local funding	3.38	1.09
Issues involved with traveling with students	3.36	1.18
Recruiting/promoting student involvement with PTSOs	3.34	1.12
Developing curriculum-based School-to-Work and/or School-to-Career activities	3.31	1.24
Conducting needs assessments to determine Programs of Study / Pathways	3.23	0.95
Conducting an adult program	3.22	1.26
Integrating CTSO activities into the regular classroom	3.21	1.14
Establishing and organizing co-op/internships	3.20	1.13
Fundraising for CTSOs	3.03	1.22
Grant writing and funding opportunities	2.99	1.20

[1]Response Scale of 1=Not Competent, 2=Little Competence, 3=Somewhat Competent, 4=Competent, 5=Very Competent.

Objective Four: Determine perceived professional needs of Idaho skilled and technical science teachers in the specific area of program management

In-service need is represented by the mean weighted discrepancy score (MWDS) as reported in Table 5. The highest rated program management in-service training need was “Grant writing and funding” (MWDS = 4.85), followed by “Developing curriculum-based School-to-Work and/or School-to-Career activities” (MWDS = 3.44), “Establishing and organizing co-op/internships” (MWDS = 3.32), “Developing an effective public relations program” (MWDS = 3.16), and

"Providing guidance & career exploration activities to students" (MWDS = 3.04) respectively.

Table 5

Program Management Priority Areas for Professional Development of Idaho Secondary Skilled and Technical Science Educators

Topic	Rank	MWDS [1]
Grant writing and funding opportunities	1	4.85
Developing curriculum-based School-to-Work and/or School-to-Career activities	2	3.44
Establishing and organizing co-op/internships	3	3.32
Developing an effective public relations program	4	3.16
Providing guidance & career exploration activities to students	5	3.04
Understanding federal (Perkins), state, and local funding	6	3.01
Program related trends and current issues	7	2.77
Coordinating activities with local organizations/agencies	8	2.52
Develop and maintain required safety standards (State and Federal/OSHA standards)	9	2.00
Issues involved with traveling with students	10	1.96
Fundraising for CTSOs	11	1.95
Establishing and using a program advisory committee	12	1.92
Recruiting/promoting student	12	1.92

involvement with PTSOs		
Evaluating a PTE program	14	1.89
Identifying appropriate course textbooks, references, and materials	15	1.72
Developing relations with fellow teachers and administrators	16	1.44
Conducting needs assessments to determine Programs of Study / Pathways	15	1.41
Integrating CTSO activities into the regular classroom	18	1.40
Determining PTE program content for specific courses	19	1.31
Career Clusters and Programs of Study / Pathways	20	0.54
Completing reports for local and state agencies	21	0.30
Conducting parent/teacher conferences	22	0.11
Planning and conducting student field trips	23	0.03
Conducting an adult program	24	-0.75

[1]Mean Weighted Discrepancy Score.

Conclusions, Discussion, and Recommendations

This study is part of a larger project to identify perceived professional development needs of Idaho career and technical education teachers. Specifically, this study sought to determine the perceived in-service needs for skilled and technical science teachers for the program management construct. Perceived needs may be different from actual needs. Teachers may perceive that an item is not an in-service need, whereas others in the profession such as state administrators or university teacher educators could arrive at a different conclusion. Because of the difference between perceived and actual needs; Idaho CTE staff, university teacher education faculty, teachers, and others involved with professional development planning might consider the use of this as part of the overall decision-making process.

Other states might consider using this study as a guide in determining teacher in-service needs. However; CTE administrators, university teacher educators, and other education professionals should take into account the nature of Idaho and its educational system. As stated earlier, Idaho is a rural state with a sparse population which is centered around the largest city and state capital. The economy of the state revolves around agriculture and natural resources; however there is significant employment in technology manufacturing. These factors need to be taken into consideration by other state CTE stakeholders as they evaluate the findings of this study.

The purpose of this study was to determine the perceived program management professional development needs of Idaho skilled and technical science teachers using a modified version of the Borich Needs Assessment Model adapted from previous research in agricultural education (Duncan et al., 2006; Garton & Chung, 1996; Joerger, 2002). Previous agricultural education researchers have identified completing administrative reports, preparing FFA degrees and awards applications, utilizing advisory committees, developing effective public relation programs, and advising students who have an interest in post-secondary education as perceived program management in-service needs by teachers (Duncan et al. 2006; Joerger, 2002; Layfield & Dobbins, 2002; Edwards & Briers, 1999; Mundt & Connors, 1999; Garton & Chung, 1997).

Utilizing the mean weighted discrepancy score, this study found that grant writing and funding opportunities were determined to be the overwhelming perceived professional development need. It is difficult to compare this finding with previous research due to the different disciplines being studied and the significantly different economic climate facing the United States. Because of the economic slowdown, Idaho educational programs, and specifically skilled and technical science programs, have faced declining financial support from the public funding sources. This phenomenon is not unique to Idaho and reflects national trends in educational funding. The findings of this study make it clear that skilled and technical science teachers have an interest in pursuing funding sources other than the status quo. By providing professional development activities that provide teachers with the skills and knowledge necessary to identify and secure financial resources, teacher educators and state CTE staff can help to ensure vibrant and effective programs that meet the needs of the students they serve. It should be noted that the ability and effectiveness of meeting this in-service need might be negatively affected by budget reductions cuts at teacher preparation institutions and by the state CTE division.

A perceived need for training related to grant writing and funding opportunities should raise concerns about the viability and sustainability of CTE programming through the public school system. Since the Smith-Hughes Act of 1917, CTE has been supported through public funding at the federal level. This funding has been continued by recent legislation such as the Perkins Act (Phipps, Osborne, Dyer, & Ball, 2008). Historically, Idaho has also financially supported CTE programs. The CTE profession should be concerned with future funding trends related to the viability and sustainability of programs and curriculum. Teachers should be applauded for having an interest in securing supporting funds for their programs; however, if implemented, this effort would probably reduce instruction and curricular development activities.

Three of the top five perceived in-service needs were related to program curriculum development: developing curriculum-based school-to-work and/or school-to-career activities, establishing and organizing co-op/internships, and providing guidance and career exploration activities to students. Teachers understand the importance of providing students with opportunities that will prepare them to successfully enter the workforce. In this age, it is of the utmost importance to provide teachers with the resources necessary to effectively prepare students to meet global employment demands.

An interesting demographic finding of this study was the high percentage of teachers whose highest level of education was a high school diploma. One of the aspects of the *No Child Left Behind Act* is the requirement of a highly qualified teacher in every classroom (NCLB, 2002). In some states and some content areas, qualification for the highly qualified classification requires at the minimum, a bachelor's degree (Smith & Gorard, 2007). Idaho provides an advanced certification for skilled and technical science teachers who have completed a degree in teacher education; however, teachers are not required to obtain this level of certification to maintain a teaching credential (Idaho Department of Education, 2006). Many Idaho public schools place teachers with degrees at a higher salary level than those without degrees. One could infer from this finding that a significant number of skilled and technical science teachers, who as a part of professional development plans, might benefit from courses that lead to the completion of an associate's degree, at a minimum. Future research should be conducted to determine the most effective and efficient methods to meet this in-service need.

Review of pertinent research literature failed to discover studies using similar methodology outside of agricultural education in the CTE content areas, and it is difficult to compare the results of this study with the in-service needs of skilled and technical science (trades and industry) teachers in other parts of the United States. Because of the lack of program management in-service needs research in CTE content areas outside of agricultural education, the methodology of this study may serve as a guide for other researchers in the profession and the findings used for comparison. In summary, the following are specific recommendations from this study:

1. Teacher educators, state CTE staff, teachers, and other educational professionals with a stake in Idaho skilled and technical science should use the results of this study as a guide in the development of future professional development activities;
2. Researchers in other states should use this study as a guide to determine the perceived in-service needs of skilled and technical science (trades and industry) teachers in their respective states and regions;
3. Researchers in CTE should use this study, and similar studies from agricultural education based on the Borich model, to conduct thorough professional development needs assessments across all content areas of CTE;
4. Researchers should use the results of this study as a guide to determine the specific content of professional development activities in order to meet the perceived in-service needs;
5. Follow-up evaluations should be conducted in order to determine the effectiveness of any implemented professional development activities to meet the perceived in-service needs;
6. CTE staff, teacher educators, teachers, and educational professionals with a stake in Idaho CTE

programming, should develop a timeframe to conduct future in-service needs assessment; and

7. Researchers should determine whether a need exists to provide the appropriate courses and professional development activities in order to provide teachers with an opportunity to obtain a college degree.

The professional development of CTE teachers has been identified as an important priority of the national CTE research agenda (Lambeth et al., 2008). The findings of this study are informative to those involved with the preparation and professional development of skilled and technical science teachers in Idaho, and serve to contribute to the identification of national trends concerning the professional development activities perceived as important by in-service skilled and technical science teachers.

References

Barrick, R. K., Ladewig, H., & Hedges, L. (1983). Development of a systematic approach to identifying technical in-service needs of teachers. *The Journal of American Association of Teacher Educators in Agriculture, 24*(1), 13-19.

Borich, G. D. (1980). A needs assessment model for conducting follow-up studies. *Journal of Teacher Education, 31*(1), 39-42.

Boser, R., & Daugherty, M. (1994). In-service activities for Technology Education: The role of colleges and universities. *Journal of Technology Education, 6*(1).

Dillman, D. A. (2007). *Mail and Internet Surveys: The Tailored Design, Second Edition – 2007 update.* Hoboken, NJ.: John Wiley.

Dobbins, T. R., & Camp, W. (2000). *Clinical experiences for agricultural teacher education programs in North Carolina, South Carolina, and Virginia.* Paper presented at the Proceedings of the27th Annual National Agricultural Education Research Conference, San Diego, CA.

Duncan, D. W., Ricketts, J. C., Peake, J. B., & Uesseler, J. (2006). Teacher preparation and in service needs of Georgia agriculture teachers. *Journal of Agricultural Education*, *47*(2), 24-35.

Edwards, M. C., & Briers, G. E. (1999). Assessing the in-service needs of entry-phase agriculture teachers in Texas: A discrepancy model versus direct assessment. *Journal of Agricultural Education, 40*(3), 40-49.

Garton, B. L., & Chung, N. (1996). The in-service needs of beginning teachers of agriculture as perceived by beginning teachers, teacher educators, and state supervisors. *Journal of Agricultural Education, 37*(3), 52-58.

Garton, B. L., & Chung, N. (1997). An assessment of the in-service needs of beginning teachers of agriculture using two assessment models. *Journal of Agricultural Education*, *38*(3), 51-58.

Greenan, J. P., Mustapha, R., Wu, M., & Ncube, L. (1998). Attitudes and motivations of vocational teachers regarding program improvement. *Journal of Industrial Teacher Education, 35*(3).

Heath, M., Dimock, K. V., Adams, S., & Zuhn, J. (1999). *Restructuring teaching with technology and constructivism.* Paper presented at the Society for Information Technology and Teacher Education International Conference (SITE).

Heath-Camp, B., & Camp, W. (1990). What new teachers need to succeed. *Vocational Education Journal*, *65*(4), 22-24.

Joerger, R. M. (2002). A comparison of the in-service education needs of two cohorts of beginning Minnesota agricultural education teachers. *Journal of Agricultural Education, 43*(3), 11-24.

Idaho State Department of Education (2006). *Idaho certification manual*. Retrieved from *http://www.sde.idaho.gov/site/teacher_certification/certProTechEdu.htm*

Lambeth, J. M., Elliot, J., & Joerger, R. M. (2008). The national Career and Technical Education research agenda. *Techniques, 83*(7), 52-55.

Layfield, K. D., & Dobbins, T. R. (2002). In-service needs and perceived competencies of South Carolina agricultural educators. *Journal of Agricultural Education*, *43*(4), 46-55.

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education, 42*(4), 43-53.

Lu, C., & Miller, L. (2002). Instructional Technology Competencies Perceived as Needed by Vocational Teachers in Ohio and Taiwan. *Journal of Vocational Education Research*, *27*(3), 319-329. Retrieved from ERIC database.

Miller, L. E., & Smith, K. (1983). Handling non-response issues. *Journal of Extension, 21*(5), 45-50.

Mundt, J. P., & Connors, J. (1999). Problems and challenges associated with the first years of teaching agriculture: A framework for preservice and in-service education. *Journal of Agricultural Education, 40*(1), 38-48.

No Child Left Behind Act of 2001, Pub. L. No. 104-110, 115 Stat. 1425 (2001).

Phipps, L. J., Osborne, E. W., Dyer, J. E., & Ball, A. L. (2008). *Handbook on agricultural education in public schools*. United States: Thomson-Delmar Learning.

Radhakrishna, R., & Doamekpor, P. (2008). Strategies for generalizing findings in survey research. *Journal of Extension, 46*(2).

Ricketts, J. C., Duncan, D. W., & Peake, J. B. (2006). Science achievement of high school students in complete programs of agriscience education. *Journal of Agricultural Education*, *47*(2), 48-55.

Smith, E., & Gorard, S. (2007). Improving teacher quality: lessons from America's No Child Left Behind. *Cambridge Journal of Education*, *37*(2), 191-206. doi:10.1080/03057640701372426.

Wash, S., Lovedahl, B., & Paige, W. (2000). A comparison of traditionally and alternatively certified technology education teachers' professional development and receptivity to change. *Journal of Industrial Teacher Education*, *37*(2), 31-46.

Identification of Quality Visual-based Learning Material for Technology Education

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In learning environments, the visual elements of courses, lessons, and presentations play an important role in learning. Well-conceived and rendered visuals help any audience understand and retain information (Wileman, 1993).

It is widely known that the use of visual technology enhances learning by providing a better understanding of the topic as well as motivating students. Visualization methods are extensively credited for simplifying the presentation of difficult subjects as well as aiding cognition; their use in the power engineering industry and education is enjoying significant growth (Idowu, Brinton, Hartmn, Nehard, Abraham, Boyer, 2006). Content visualization can facilitate the learner's acquisition of information. It is related to the individual's level of perceptual and associative learning in the content area. The individual must have sufficient experience and maturity to realize that using visualization is merely an attempt to represent reality vicariously (Dwyer, 1978). Much of intended visual communication or self-expression is not perceived, or often misunderstood, especially if it is complex (Lantz, 2000).

If all visual-based learning materials (tables, figures, photos, etc.) were equally effective in facilitating student achievement of all kinds of educational objectives, there would virtually be no problem associated with this type of instruction (Dwyer, 1978). However, this is not the case since there are many different types of visuals, differing in the amount of realistic detail they contain. When comparing wireframe and a

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three dimensional drawings (see Photo 1) the difference in the amount of information that is given to the reader is substantial. At the present time, educators, when faced with a choice of selecting one type of visualization from an array of available materials, have no way of knowing whether one type of visual is any more effective than another in transmitting specific types of information (Dwyer, 1978). From past to current there has been a lack of quantifiable measures of quality and benchmarks that will undermine information visualization advances, especially their evaluation and selection (Chaomei, 2005). The significance of this dilemma is brought into focus when one becomes aware of the amount of visual-based learning materials that are being used today in the private and public educational sectors. As might be expected, the types of visual-based materials used for instructional purposes are the ones that have become most readily available (Dwyer, 1978). However, the extensive use of certain types of visual-based materials does not necessarily justify their effectiveness and efficiency.

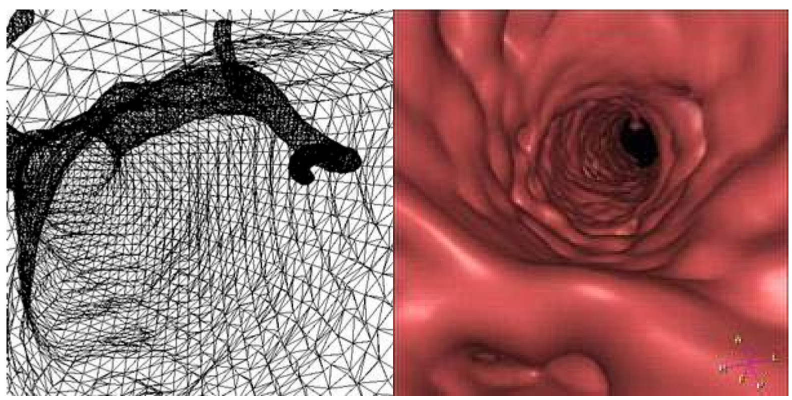


Photo 1. Virtual Endoscopy in the Aorta; Comparison between wireframe and 3D drawing. Thomas Deschamps Mathematics Department Computational Research Division Lawrence Berkeley Laboratory.

The importance of knowing how to select the best type of visual-based learning materials is recognized throughout higher education; however, with the exception of some descriptive literature, few studies have been conducted to identify the essential indicators of useful visual-based learning materials in technology education courses for the middle and high school grades (Lantz, 2000). The reason this is being emphasized for grades 7-12 is because technology education is mainly offered in those grades due to federal funding guidelines such as the Carl D. Perkins Vocational and Technical Education Act (2006) that provides federal funds "…to help provide vocational-technical education programs and services to youth and adults in middle school, high school and college level" (Wileman, 1993, p.3).

Since the early 1980s there has been little research to use when selecting specific types of visuals that will be most effective and efficient in facilitating student achievement of designated learning objectives. What is needed is systematic research efforts focused on three basic areas designed to provide data on: (a) what specific individual difference variables in learners actually make a difference in student achievement in the teaching learning process, (b) which of these individual difference variables interact significantly with different kinds of visualization used to complement oral/printed instruction, and (c) what is the extent of the range within specific individual difference variables that are accommodated by the use of specific types of visualization (Dwyer, 1978).

Once one can describe what makes a particular visual successful, it can be applied to the design to enhance visuals. In instruction, an image may be studied for a long time by the viewer and still not be useful (Lantz, 2000). Therefore, it is essential to identify the indicators of quality visual-based learning materials for technology education curricula and other

K-12 instruction. Moreover, it is important to validate these indicators through involvement of educational members in the field of visual learning and technology education. These include technology education experts who have knowledge related to visual learning and practical experience, are involved in the creation of related materials, are a useful source of information to develop and validate the indicators of visual-based learning materials for technology education.

Research Questions and Hypotheses

The major emphasis of this study involved determining quality indicators of visual-based learning material in technology education for grades 7-12 to transmit information effectively, and also quality indicators of the learner's characteristics to be exposed to such material. To achieve this task two research questions were proposed dealing with visual-based learning material:

1. What indicators must visual-based learning material in technology education for grades 7-12 have to be effective in transmitting information?
2. What are the indicators of the learner's characteristics that impact the selection of visual-based learning material in technology education for grades 7-12?

From these research questions, four hypotheses were created. The null and alternative hypotheses were:

H1: The median of the middle school population for each quality indicator for visual based learning material in technology education for grades 7-12 equals the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.

H0: $\Theta 1 = \Theta 2$.

The alternative hypothesis for this test was:
With respect to at least one of the inequalities, the median of the middle school population for each quality indicator for visual-based learning material in technology education for grades 7-12 is greater than the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.
H0: Θ1 < > Θ2.

The null hypothesis for this test was:

H2: The median of the middle school population for each quality indicator for visual-based learning material in technology education for grades 7-12 equals the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.
H_0: $\Theta_1 = \Theta_2$.

The alternative hypothesis for this test was:

With respect to at least one of the inequalities, the median of the middle school population for each quality indicator for visual-based learning material in technology education for grades 7-12 is greater or less than the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.
H_0: $\Theta_1 > \Theta_2$ or H_0: $\Theta_1 < \Theta_2$

H3: In the underlining population the sample represents the correlation between the ranks of subjects on middle school responses and high school responses equal some value higher than 0.
H_0: $\rho_s > 0$

The alternative hypothesis for this test was:

In the underlining population the sample represents the correlation between the ranks of subjects on middle school responses and high school responses equals some value lower or equal to 0.

$H_0: \rho_s \leq 0$

The null hypothesis for this test was:

H4: The median of the middle school population for each quality indicator for visual based learning material in technology education for grades 7-12 equals the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.

$H_0: \Theta_1 = \Theta_2$.

The alternative hypothesis for this test was:

With respect to at least one of the inequalities, the median of the middle school population for each quality indicator for visual-based learning material in technology education for grades 7-12 is greater than or less than the median of the high school population for each quality indicator for visual-based learning material in technology education for grades 7-12.

$H_0: \Theta_1 > \Theta_2$ or $H_0: \Theta_1 < \Theta_2$

Research Methodology

The Delphi technique for achieving consensus among experts was determined to be the best method for the purpose of this study. Studies comparing the Delphi's results with other methods confirmed the effectiveness of the method related to generating ideas and the use of participants' time (Ulschak, 1983). Lang (1998) described the Delphi method as the best known qualitative, structured, and indirect interaction research method to study current and future events.

Three rounds were conducted to achieve consensus among a group of experts in visual based learning materials who were experienced technology teachers involved in pilot and field-testing for visual-based learning material for grants such as Visualization in Technology Education, VisTE (VisTE, 2006) and TECH-Know (TECH-Know, 2004). Table 1 is a descriptive summary of the number of panel members and the geographic regions they represented. All individuals were technology education teachers and were involved in a grant. Eleven of the individuals were high school teachers and eight middle school teachers. For eight of the panel members, the baccalaureate was the highest degree held, while ten held a master's degree or higher.

Table 1

Summary of Demographic Information on Expert Panel

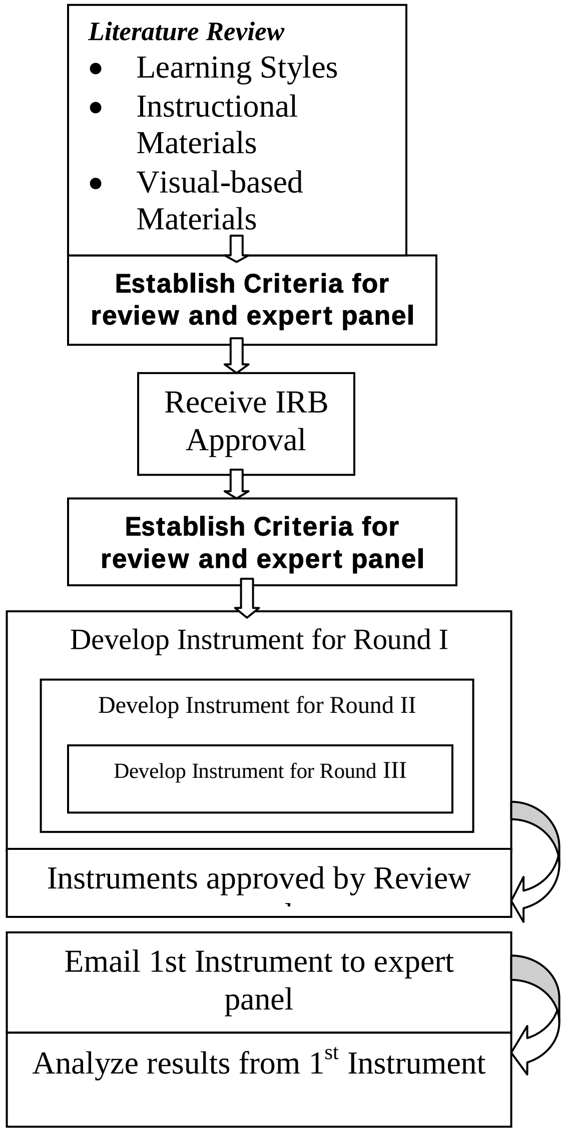
Description	Frequency	Percent
Technology Teacher	19	100.0
Grant Participant	19	100.0
Author	2	10.5
High School Grades	8	42.1
Middle School Grades	11	57.9
Male	11	57.9
Female	8	42.1
Bachelor's Degree Holders	9	47.4
Master's Degree Holders	10	52.6

Note. Total percent for all categories combined is 100 percent.

Quality indicators included in Round I instrument of this modified Delphi were derived through literature review. Examples of quality indicators were established and placed in a survey instrument. Once a review panel approved the instrument, the expert panel was given access to the instrument on the web through a username and password. See Figure 1. An email was sent to panel members after two weeks as a reminder to complete and return the instrument. Results from Round I were tabulated, with like indicators collapsed together.

Round I of the modified Delphi method began with the development of a questionnaire to identify the quality indicators of visual-based learning material in grades 7-12 for technology education programs. The questionnaire gave directions and definitions that were critical to the participant as well as to the study so that every panel member was using the correct format when completing the questionnaire. It also used the same definitions of key terms used in the instrument. Examples of related indicators from the review of literature were presented to aid the participants in format for typing a new indicator or modifying an existing one, as well as to start the brainstorming process.

Participants remained anonymous to each other, avoiding influences of reputation, authority, or affiliation. This enabled panel members to change their opinions without losing face (Lantz, 2000). Round II of the modified Delphi method included the rating and ranking of indicators from Round I. The instrument was developed and sent to the review panel for verification. The indicators were placed in random order. This round consisted of rating each indicator from the previous round. Indicators with a mean of 3.01 or higher from a Likert scale of 1-5 were kept for the next round. Round III consisted of ranking the information gathered from Round II. Indicators kept from this round were those that ranked in the 50 percent above the statistic mean from Likert scale (Clark & Mathews, 2000).



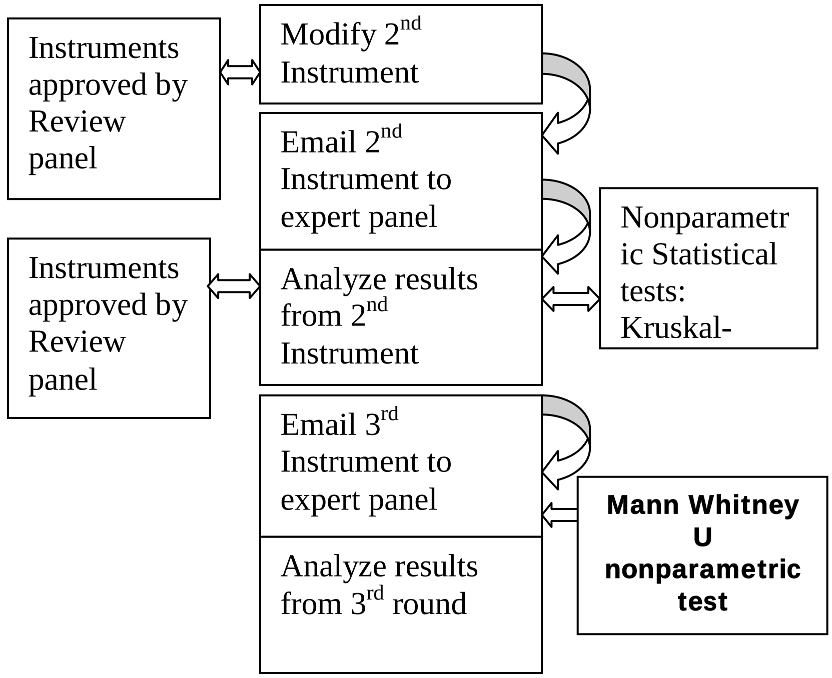


Figure1. Outline of Research

Findings

The major emphasis of the study involved determining the indicators for visual-based learning material to be used in technology education for grades 7-12. These indicators must transmit information effectively and must be based on the characteristics of learners who will be exposed to such material. In the three modified Delphi rounds, a panel of experts in the field of technology education identified visual based quality indicators through a consensus process. The modified Delphi method used in this study validated the quality indicators through the use of consensus-drawing processes.

Stratification measures used for locating expert panel members helped ensure that the indicators represented consensus from across the United States. The statistical tests applied during the study validated that consensus was being achieved and thus consensus-gathering strategies used within the study were appropriate.

In Round I the majority of the indicators suggested by the expert panel members was alike in meaning, but defined with different wording. The study started 7 indicators and the total number of new indicators suggested by the expert panel members at the end of Round I was 12. Table 2 shows the example indicators modified by the researcher to meet the suggestions made by the expert panel. These modifications were approved by the review committee prior to being accessed by the panel of experts in Round II. The panel members could keep or reject any example indicators given to them in this round or modify the example indicators. The majority of the panel members, 90.5 percent, completed and returned the questionnaire. The majority of respondents, over 99.0 percent, suggested keeping most of the example indicators.

Table 2

Examples of Modifications Made to Indicators from Round I to Round II

The effectiveness of visual-based learning material in Technology Education for grades 7-12 depends upon:

Indicator for Round I	Modifications to Indicator For Round II
The amount of realistic detail contained in the visualization used.	The amount of detail contained in the visualization used.
The method by which the visualized instruction is presented to the student.	The method by which the visualized instruction is presented since method varies on students.
The type of the educational objective to be achieved by the students.	How the objectives are presented to the students.

Round 2 of this study allowed the panel of experts to rate and rank all indicators from Round I. The rating process used a Likert Scale of 1 to 5 with the following classifications for each rating number: (1) represented a strong disagreement that the effectiveness of visual-based learning material in technology education depends on the specific indicator; (2) represented disagreement that the effectiveness of visual-based learning material in technology education depends on the specific indicator and meets 49% or less of all quality characteristics; (3) represented a neutral position that the effectiveness of visual-based learning material in technology education depends upon the specific indicator and is appropriate for 51% or more of all quality indicators; (4)

represented an agreement that the effectiveness of visual-based learning material in technology education depends on the specific indicator and is appropriate for 75% or more of all quality indicators; and (5) represented a strong agreement that the effectiveness of visual-based learning material in technology education depends on the specific indicator and is appropriate for 100% of all quality indicators.

Once all data were collected, statistical means and standard deviations were calculated for each indicator. The indicators with a mean of 3.01 or higher were kept for the next round. The mean of 3.01 indicated that the modified Delphi process was starting to reach consensus by keeping only those indicators that had a rating at or above the statistical median of 3.01 for the rating scale of one to five. This assured the researcher that overall the indicators kept were appropriate for at least 51 percent of the visual-based learning materials in technology education for grades 7-12. Table 3 shows the indicators the expert panel members rated and the overall means and standard deviations for each category and indicators from round two of the modified Delphi method.

The statistical tests included the non-parametric Kruskal-Wallis test to determine whether there was a significant difference between the middle school experts' opinions and the high school experts' opinions. The results showed no significant difference, which indicated well-written indicators, strong consensus, and agreement among experts. The Mann-Whitney U test (see Table 4) was employed to test a hypothesis of a design with two independent samples to determine if significant differences occurred between the medians of expert populations. The results showed few significant differences, which indicated strong consensus among experts.

Table 3

Indicators Overall Means and Standard Deviations for Round II Indicators

The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:

	M	SD	N
The amount of detail contained in the Visualization used.	3.35	1.23	20
The method by which the visualized instruction is presented since method varies on students.	4.15	.49	20
The students' interests and engagement.	4.7	.73	20
How the objectives are presented to the students.	4.05	.83	20
The amount of information students acquire by means of visualized instruction).	3.55	.94	20
The instructor's ability to effectively and efficiently integrate visual-based learning material into the Technology Education classroom environment and curriculum.	4.15	.75	20
Time spent teaching background knowledge.	3.5	1.15	20
The quality of the Visualization used.	4	56	20
The relevance of the materials.	4.25	.79	20
The direct correlation between the materials and the learning objective.	3.6	.75	20
The level of the technology available to the student.	3.6	1.05	20
The hardware being used by the student.	3.85	1.18	20

The teacher's confidence in the area of visual teaching.	4.05	.76	20
The amount of equipment i.e. computers available.	3.4	1.10	20
The amount of training the instructor has with equipment i.e. software.	3.85	.75	20
Learning style of the students to which the visual material is presented.	4.4	.60	20

Table 4
Spearman's Rho, Kruskal-Wallis and Mann-Whitney results for Visual-based learning material quality indicators

Ind #	**The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:**	**High r****	**Middle r****	**Mid. Mdn**	**High Mdn**	**Kruskal P-value**	**Mann P-value**
1	The amount of detail contained in the Visualization used.	0.827	0.967	9	13	0.2083	0.1966
2	The method by which the visualized instruction is presented since method varies on students.	0.980	0.856	7	6.5	0.6147	0.9393

Note. $p < .05$, ** Assumption not held true, ** r represents the*

Spearman's (Rho) for an indicator

Ind #	**The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:**	**High r****	**Middle r****	**Mid. Mdn**	**High Mdn**	**Kruskal P-value**	**Mann P-value**
3	Students' interests and engagement.	0.827	0.848	2.5	3	0.3986	0.3383
4	How the objectives are presented to the students.	0.980	0.976	6.5	7.5	0.3297	0.9093
5	The technique used to focus student attention on the essential learning characteristics in the visualization materials, (e.g., cues such as questions, arrows).	0.169	0.127	12	2.5	0.8018	0.0110*
6	The type of assessment employed to evaluate student learning.	0.945	0.895	13	8.5	0.6138	0.6749

Note. $p < .05$, * *Assumption not held true,* ** r *represents the Spearman's (Rho) for an indicator*

Ind #	**The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:**	**High r****	**Middle r****	**Mid. Mdn**	**High Mdn**	**Kruskal P-value**	**Mann P-value**
7	The instructor's ability to effectively and efficiently integrate visual-based learning material	0.994	0.945	8.5	5.5	0.7199	0.6749
8	Time spent teaching background knowledge	0.848	0.812	13	10.5	0.2287	0.7329
9	The quality of the Visualization used.	0.909	0.867	9.5	13.5	0.9627	0.1715
10	The student’s ability to effectively and efficiently understand integrated visual-based learning mat’l into the Tech Ed classroom environment and curriculum.	1.000	0.945	5	6.5	0.805	0.4009

Note. p < .05, * Assumption not held true, ** r represents the Spearman's (Rho) for an indicator

Ind #	**The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:**	**High r****	**Middle r****	**Mid. Mdn**	**High Mdn**	**Kruskal P-value**	**Mann P-value**
11	The relevance of the materials	0.782	1.000	5.5	10.5	0.3921	0.0527
12	The direct correlation between materials and the learning objective.	0.803	0.837	11.5	10.5	0.5565	0.7004
13	The level of the technology available to the student,	0.909	0.976	6	15.5	0.1747	0.0436*
14	The hardware being used by the student.	0.894	-0.188*	11	16.5	0.379	0.1831
15	The teacher's confidence in the area of visual teaching.	0.945	0.809	7.5	7.0	0.3297	0.6761

Note. $p < .05$, * Assumption not held true, ** r represents the Spearman's (Rho) for an indicator

Ind #	**The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:**	**High r****	**Middle r****	**Mid. Mdn**	**High Mdn**	**Kruskal P-value**	**Mann P-value**
16	The amount of equipment i.e. computers available.	0.994	0.164*	13	10.5	0.3158	0.6220
17	The amount of training the instructor has with equipment i.e. software.	10	10	8.5	7	0.8678	0.5956
18	Learning style of the students to which the visual material is presented.	0.976	0.848	9	5.5	0.0897	0.1836

Note. $p < .05$, * Assumption not held true, ** r represents the Spearman's (Rho) for an indicator

The Spearman's Rho nonparametric test was used to show a positive coefficient correlation between the middle and high school populations responses found in Round 2. The results showed a strong positive correlation coefficient for the composite set of indicators as well as positive coefficient for all except 2 of the individual indicators.

The modified Delphi method used in this study validated the quality indicators through the use of consensus-drawing processes using experts involved with visual-based learning material grants. Stratification measures used for locating expert panel members helped ensure that the indicators represented consensus from across the United States. The statistical tests applied during the study validate that consensus was being achieved during the study and that consensus-gathering strategies used within the study were appropriate. Table 5 shows the validated indicators kept from the final modified Delphi round of this study.

Table 5
Validated Indicators kept from Final Round

Ind. #	The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:
1	The amount of detail contained in the Visualization used.
2	The method by which the visualized instruction is presented since method varies with students.
3	Students' interests and engagement.
4	How the objectives are presented to the students
5	The technique used to focus student attention on the essential learning characteristics in the visualization materials, (e.g., cues such as questions, arrows, motion, verbal/visual feedback).
6	The type of assessment employed to evaluate student learning, (e.g. for certain types of educational objectives visual tests have been found to provide more valid assessments of the amount of information students acquire by means of visualized instruction).

Ind. #	The effectiveness of Visual-based learning material in Technology Education for grades 7-12 depends upon:
7	The instructor's ability to effectively and efficiently integrate visual based learning material into the Technology Education classroom environment and curriculum.
8	Time spent teaching background knowledge
9	The quality of the Visualization used
10	The student's ability to effectively and efficiently understand integrated visual-based learning material into the Technology Education classroom environment and curriculum
11	The relevance of the materials
12	The direct correlation between the materials and the learning objective.
13	The level of the technology available to the student.
14	The hardware being used by the student
15	The teacher's confidence in the area of visual teaching

Discussion

According to Haynie (1978), the value of visual illustrations in instruction has been known for some time and several researchers such as Bell, Cain, and Lamorlaux (1941), Dwyer (1965), Gropper (1962), McCowen, (1940), Murray (1960), Vernon (1945, 1946), Wiman and Meierhenry (1969), and Wise (1939) have found that using visual aids can improve student achievement in specific learning objectives. Several studies were conducted to compare the effectiveness of various media and methods. Haynie mentions that early studies of the type criticized by Lumsdaine and May (1965) include Brown (1928) which compared motion pictures to film slides and McCowen (1940), Murray (1960), and Vernon (1945) which compared the use of visuals to conventional methods of instruction.

Visualization has been identified as one of the most important skills related to engineering and technical graphics (Gillespie, 1995). "Spatial visualization skills are an important component of engineering because of their direct relationship to the graphical communication associated with design" (Devon et al., 1994, p. 4). Strong spatial visualization skills have been shown to correlate to success, achievement, and retention in engineering programs and success in mathematics (McGee, 1979). Vocational students have had difficulty translating 2-D schematics and blueprints into 3-D objects and converting 3-D objects into 2-D representations. This may be due to the lack of development of visualization skills (Rosenfeld, 1985). Visualization is particularly important to engineers because they must be able to solve problems involving abstract objects. They need to be able to communicate those solutions and understand the drawings or solutions of others (Mack, 1992).

The value of visualization and capabilities goes even beyond the ordinary. Having the list of the quality indicators (see Table 5), educators should be able to make informed decisions relating to the appropriateness of the material for specific classes. Knowing for example that the amount of detail in the visualization (Table 5, Indicator 1) has a significant impact toward learning; educators will choose material that includes those characteristics. Student learning styles vary, including aural, kinesthetic, visual, read and write; therefore, it will be expected that the method by which the visualized instruction is presented will make a significant difference. It was very interesting to see that one of the quality indicators (Table 5, Indicator 2) deals with that specific subject. It was also interesting to see that some of the indicators (Table 5, Indicators 5, 7 and 15) stressed the importance of the instructor's background towards visual-based learning material teaching techniques, and how they contribute to better understanding. Factors such as background knowledge, technique used to focus student attention and ability to effectively and efficiently integrate the material are important.

Despite recognition of the many benefits of visual-based learning material in grades 7-12 technology education, there are as of yet no rigorous, well tested, standards based-nationally distributed materials to support such instruction in American high schools (Wiebe, Clark, Ferzli and McBroom, 2003).

Even as the nation's high schools technology education classes have begun using sophisticated equipment and content that supports visual based material, many have remained narrowly focused on traditional applied technology areas. Having a set of indicators such as the ones identified in this study should enhance understanding and research related to visual-based learning. Teachers should now be able to make a better selection on what kind of visual-based material should be used. Now is the time for educators to step forward with the vision needed to strengthen visual-based material for technology education programs. The indicators presented in this study should be the starting point for discussions and change. Finally, the implications for future studies, recommendations, and suggestions are stated.

Recommendations for Further Research

The findings of this research suggested many possible recommendations for further study in the areas of quality visual-based learning material in technology education programs for grades 7-12 and the use of the Delphi method as a research tool. The following recommendations are suggested for further study.

1. Additional research is needed to establish and assess quality indicators for visual-based learning material in technology education for all grades. This includes elementary, middle school, high school, and college level.
2. Additional studies should be conducted using other research methodologies to better understand the subject matter and aid in validating the information gathered.
3. This study should be replicated in five years to see if new quality indicators are identified for visual-based learning material in technology education programs for grades 7-12, and the information should be updated in the final quality indicators list for a more representative up-to-date assessment of visual-based learning materials.
4. Additional research is needed in developing an assessment strategy and model for assessing quality visual-based learning material in technology education programs for grades 7-12 at the national and international level.
5. Additional research to validate assessment tools that aid the selection process of quality visual-based learning material in technology education programs for grades 7-12 at both the national and international levels.
6. Additional research should be conducted to define the difference between visual data and information

collected from studies such as this one could be beneficial to pre-engineering education and K-12 outreach through the expansion of research and knowledge in general. Visual-based learning courses have a great potential to become a significant part of K -12 pre-engineering education.

References

Bell, R., Cain, L. F., & Lamorlaux, L. A. (1941). *Motion pictures in a modern curriculum* -- *a report on the use of films in the Santa Barbara Schools.* Washington, D.C.: American Council of Education.

Branoff, T. (1998). *Coordinate Axes and Mental Rotation Tasks: A Dual-Coding Approach*. Paper presented at the meeting of The American Society for Engineering Education, Seattle, WA.

Chaomei, C. (2005). *Top 10 unsolved information visualization problems*. Philadelphia, PA: IEEE Computer Society.

Clark, C. A., & Mathews, B. (2000). Scientific and technical visualization: A new course offering that integrates mathematics, science and technology. *Journal of Geometry and Graphics*, *4*(1), 89-98.

Clayton, M. J. (1997). *Delphi: A technique to harness expert opinion for critical decision making tasks in education*. *Educational Psychology, 17*(4), 373-386.

Delbecq, L., Van deVen, H, & Gustafson, H. (1975). *Group Techniques for ProgramxPlanning: A Guide to Nominal Group and Delphi Processes*. New York: Scott-Foresman.

Devon, R., Engel, R. S., Foster, R. J., Sathianathan, D., & Turner, G. F. (1994). The effects of solid modeling software on 3-D visualization skills. *Engineering Design Graphics Journal, 58*(2), 4-11.

Dwyer, F. M. (1965). *An experimental evaluation of the relative effectiveness of selected visual illustrations in teaching science concepts to college freshmen*. Unpublished doctoral dissertation, The Pennsylvania State University.

Dwyer, F. M. (1978). *Strategies for improving visual learning*. State College, PA.: Learning Services.

Ernst, V. E., Clark, A. C. (2006). Supporting technological literacy through the integration of engineering, mathematic, scientific, and technological concepts. *Published proceedings of the American Society for Engineering Education Annual Conference and Exposition*, Chicago, IL, Session 370.

Gropper, G. L. (1962). *Studies in televised instruction: the role of visuals in verbal learning*. Pittsburgh: Metropolitan Pittsburgh Educational Television Station and the American Institute for Research.

Gillespie, W. H. (1995). Using solid modeling tutorials to enhance visualization skills. *Dissertation Abstracts International, 56*, 11A. (UMI No. AAI9606359).

Haynie III, W. J. (1978). *The instructional effectiveness of realism and enhancement of illustrations as related to visual continuum theories*. The Pennsylvania State University.

Idowu, P., Brinton, G., Hartman, H., Neuhard, S., Abraham, R., & Boyer, E. (2006). *Information visualization applied in presenting some fundamental power system topics*. Published proceedings of the American Society for Engineering Education Annual Conference and Exposition, Chicago, IL, Session 1335.

Lang, T. (1998). *An overview of four futures methodologies*. October 15, 2006, Retrieved from http://www.soc.hamaii.edu/~future/j7/LANG.html

Lantz, C. (2000). Visual Readability in Instructional Images. *Visual Communications Journal, 8* (2), 19-27.

Mack, W. E. (1992). The Effect of Training in Computer-Aided Design on the Spatial Visualization Ability in Selected Gifted Adolescents. *Dissertation Abstracts International, 53*, 03A. (UMI No. AAG9500831).

McCowen, A. C. (1940). A controlled experiment in visual education in general science. *Educational Screen 19*, 143-146.

Martino, J. (1993). *Technological Forecasting for Decision Making*. New York: Elsevier Science Publishing Company.

Mayer, M. A., & Booker, J.M. (1990). *Eliciting and analyzing expert judgment: A practical guide*. Washington, D.C.: U. S. Nuclear Regulatory Commission.

McCowen, A. C. (1940). A controlled experiment in visual education in general science. *Educational Screen, 19*, 143-146.

McGee, M. G. (1979). Human spatial abilities: Psychometric studies and environmental, genetic, hormonal, and neurological influences. *Psychological Bulletin, 86*(5), 889-918.

Murray, J. R. (1960). *The comparative effectiveness of condensed visualized methods in teaching operation of the VM tape recorder and Victor 16mm projector*. Unpublished doctoral dissertation, The Pennsylvania State University.

Nesbary, Dale K. (2000). *Survey Research and the World Wide Web*. Boston: Allen and Bacon.

Rosenfeld, D. W. (1985). Spatial relations ability skill training: The effect of a classroom exercise upon the skill level of spatial visualization of selected vocational education high school students. *Dissertation Abstracts International*, *46*, 06A. (UMI No. AAG8518151).

TECH-know. (2004). *TECH-know Project.* September 16, 2006, Retrieved from http://www.ncsu.edu/techknow/aboutproject.html

U. S. Department of Education. (n.d.). *The Carl D. Perkins Vocational and Technical Education Act, Public Law 105-332*. Retrieved April 17, 2003, from http://www.ed.gov/offices/OVAE/CTE/perkins.html

Ulschak, F. L. (1983). *Human resource development: the theory and practice of need assessment.* Reston, Virginia: Reston Publishing Company, Inc.

Vernon, M. D. (1945). Learning from graphical material. *British Journal of Psychology 16*, 145-158.

VisTE. (2005). *About Viste.* Retrieved September 16, 2006, from http://www.ncsu.edu/viste//aboutus.html

Virtual Endoscopy in the Aorta; Comparison between wireframe and 3D drawing. "Online image". 16 Feb. 2010. Thomas Deschamps Mathematics Department Computational Research Division Lawrence Berkeley Laboratory <http:// math.lbl.gov/~deschamp >.

Wiebe, N. E., Clark, A. C., Petlick, J., & Ferzli, M. (2004). VisTE: Visualization for Technology Education: An outreach program for engineering graphics education. *Published proceedings of the American Society for Engineering Education Annual Conference and Exposition*, Salt Lake City, UT, Session 3138.

Wileman, E. R. (1993). *Visual communicating*. Englewood Cliffs, NJ: Educational Technology Publications.

Wiman, R., & Meierhenry, W. (1969). *Educational media; theory into practice*. Colombus, Ohio: Charles Merrill Publishing Co.

Wise, H. A. (1939). *Motion pictures as an aid in teaching American History*. New Haven, Connecticut: Yale University Press.

Impact of an Engineering Mentorship Program on African-American Male High School Students' Perceptions and Self-Efficacy

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Abstract

The purpose of this study was to examine the impact of an engineering mentorship program on African-American male high school students' perceptions of engineering as a viable career choice. In this study, indicators included students' perceptions of engineering, their self-efficacy in the area of mathematics, and their self-efficacy in the area of science. Using an independent *t*-test to determine a difference of statistical significance, inferential statistics were provided to answer the following research questions: (a) Is there a significant difference in perceptions of engineering for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students?, (b) Is there a significant difference in self-efficacy in the area of mathematics for students who participated in the NCETE/NSBE mentorship when compared with non-mentored students?, and (c) Is there a significant difference in self-efficacy in the area of science for students who participated in

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the NCETE/NSBE mentorship when compared with non-mentored students?

Introduction

If the United States (U.S.) is to meet its need for world class talent in science, technology, engineering, and mathematics (STEM), it is essential that a diverse population be attracted to engineering and other technical fields (Chubin, May, & Babco, 2005). Culturally, the preclusion of minorities from technical fields has significant ramifications. According to Jenkins (1999), for minorities to be able to skillfully adapt to an ever changing economy in a capitalist society it is pertinent that they become technologically proficient in the coming years. Technological proficiency not only speaks to the understanding and manipulation of technological devices but it also speaks to increased representation in fields that require technological literacy, particularly engineering, computer science, and technology education. Technological proficiency is not only vital to the socioeconomic and educational growth of minorities; it also has implications for the nation as a whole as the U.S. strives to maintain a competitive workforce.

To effectively begin to diversify the fields of engineering and other technical fields, several challenges need to be addressed including (a) a current technical workforce that is undiversified in relation to the total workforce (Wheeler, 1996), (b) ineffective plans of action currently in use for recruitment and retention of minority students and faculty (Jeria & Gene, 1992), and (c) a pedagogical approach to STEM instruction that is culturally unresponsive (Carter, 2005). A review of literature on diversity within technical fields shows that mentorship programs have provided some answers to these puzzling challenges. Within organizations, formal mentoring programs have benefited the growth of women and minorities in the workplace by helping with assimilation to the workplace (Hansman, 2002). For the U.S. to adequately address the disadvantages of an undiversified technical workforce (Wheeler, 1996), a promising strategy is the use of interventions such as mentorship programs as a means to recruit minorities to engineering and other technical fields.

As a grass-roots initiative, mentorship programs act as a vehicle for change, satisfying the need for connections with family and community as exemplified in the following quote, "The structural and attitudinal changes required for instituting changes that transcend single professional field and agency auspices cannot occur without rooted connections with families and the community" (Oates, Weishew, & Flores, 1998, p. 53). Formal mentorship programs offer a viable approach for recruiting minorities to engineering disciplines and other technical fields by serving as extensions of these communities. As a tool of affirmative action, mentorship programs have been utilized since the 1970s and 1980s (Van Collie, 1998). Research shows that formal mentoring programs have become effective recruitment tools for many organizations seeking to recruit and retain minorities in the workplace (Allen & O'Brien, 2006). Further illustrating the feasibility of mentoring as a tool to promote diversity in technical fields, Maughan (2006) stated that mentoring has repeatedly been shown to enrich the process of learning. This enrichment of learning may in itself positively impact retention, recruiting, and knowledge management of organizational members.

Although there is research available that documents the effectiveness of mentorship programs on a student's academic success, especially for at-risk students (Campbell-Whatley, Algozzine & Obiakor, 1997; Hall 2006), there has not been much research dedicated to the examination of mentorship programs in relation to minorities' perceptions towards career choices related to engineering. Using a specialized group, this study examined the impact of a formal mentorship program on African-American male high school students' perceptions of engineering as a viable career choice. Findings from this research may provide a basis for future initiatives seeking to introduce effective strategies for recruitment and retention of underrepresented populations.

Purpose of the Study

The purpose of this study was to examine the impact of an engineering mentorship program on African-American male high school students' perceptions of engineering as a viable career choice. In this study, indicators included students' perceptions of engineering, their self-efficacy in the area of mathematics, and their self-efficacy in the area of science. This study used a two-group, posttest only, experimental design with randomly selected participants. After participation in the National Center for Engineering and Technology Education (NCETE)/National Society for Black Engineers (NSBE) mentorship program, the treatment for this study, a survey was used to collect data to answer the following research questions:

Research Questions

1. Is there a significant difference in perceptions of engineering for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students?
2. Is there a significant difference in self-efficacy in the area of mathematics for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students?
3. Is there a significant difference in self-efficacy in the area of science for students who participated in the NCETE/NSBE

mentorship program when compared with non-mentored students?

The primary construct for this study was students' perceptions of engineering as a viable career choice. Students' perceptions were understood by measuring three different variables to include; students' conceptual perception of the engineering field, students' self efficacy in the area of math, and students' self efficacy in the area of science. Students' perceptions of engineering was derived by examining students self-reporting on their understanding of engineering concepts and their confidence to perform requisite skills associated with the profession. Measures of students' perceptions included their self-efficacy in math and science due to the importance of these subject areas within the engineering profession. As noted by Wicklein (2006), an integral part of the engineering experience is the application of mathematics and science. In addition, studies have shown that a child's perception of an occupation and their self-efficacy greatly influence the decision of a child to pursue the occupation (Bandura, Barbaranelli, Vittorio, & Pastorelli, 2001). Using Bandura, Barbaranelli, Vittori and Pastorelli's (2001) previous work as a template, the researcher attempted to measure the impact of mentorship programs on students' perceptions of engineering and their perceived self-efficacy to perform tasks associated with that profession.

Rationale and Theoretical Framework

In stating a rationale for the intervention of mentorship programs, it must be reiterated that federal legislation distinctly mentions that one purpose for mentoring is to "encourage students from underrepresented groups to pursue scientific and technical careers" (U.S. Energy Policy Act, Sec. 1102, p. 10, line 16, 2006). As organizations and institutions look to meet the demanding needs of the nation's workforce, more research is needed that clearly delineates the benefits of formal mentorship programs. With respect to engineering and other technical fields, this study was particularly focused on the characteristics of mentoring and its functions in an academic setting. In this role the mentor usually acts as a sponsor who will provide his/her prospective protégé with exposure, coaching, and awareness of potential career opportunities (Allen & Day, 2002). Within the scope of the mentoring relationship, these mentoring activities are categorized by the term *career functions* (Allen & Day, 2002).

This investigative study utilized Kram's (1983) theory of mentoring in an effort to gain insight into how mentorship programs influence students' perceptions and self-efficacy. According to Kram (1983), mentoring is a relationship between an experienced member of an organization and an understudy where the experienced employee acts as a role model and provides support and direction to the protégé. Due to the dynamic characteristics of the mentoring relationship (including social interactions), social learning theory was used to extend the understanding of this relationship. Merriam and Carafarella (1999) helped identify the relevance of social learning theories in reference to mentoring by stating "Social learning theories contribute to adult learning by highlighting the importance of social context and explicating the process of modeling and mentoring" (p. 139). The inclusion of social learning theories (inclusive of social cognitive theory) as a part of the theoretical constructs relevant to mentoring is the result of social learning theory's emphasis on how social context and the environment reinforce behavior (Ormund, 1999). This theory states that people learn from one another and it includes the concepts of observational learning, imitation, and modeling.

Methodology

This study used a two-group, posttest only research design model. This research design is useful in studies where the administration of a pretest may influence the participants' behavior during the experiment or on the posttest (Gall, Gall, & Borg, 1996). The effects of the treatment administered can be measured by comparing the posttest scores of two populations. This particular research design is appropriate when trying to influence a stable characteristic such as students' perceptions and self-efficacy.

The dependent variables for the study were students' perceptions and self-efficacy, which included students' perceptions of engineering and their self-efficacy in the areas of mathematics and science after participating in the NCETE/NSBE mentorship program. The mentorship program that the students participated in represented the treatment for the study. This research study was carefully designed and yielded useful information that could be generalized within margins of error to the target population of male high school students attending comparable alternative high schools that cater to "at-risk" male minority students.

Random assignment was used in this study to select participants, thus allowing all African-American male students attending the alternative high school an equal opportunity to be selected for the study. Factors of internal invalidity that were of particular concern were differences in the individual's history, maturity level and individual attrition rates as it relates to test taking. Random assignment among the participants was employed in an effort to spread the measurement error across the sample population.

Participants

The participants in this experiment were drawn from an alternative high school in North Carolina, which began in 2003 as an initiative designed to offer young men a new chance at success. The alternative high school is a single gender high school in North Carolina that provides smaller classes and a nurturing environment with the goal of boosting self-esteem and providing opportunities for a promising future to at-risk male students. In the literature, the term “at-risk” represents a construct used to designate a high probability of poor development and low academic achievement (Werner, 1986). At-risk students also suffer from a sense of alienation from the culture of schools (Fine, 1986). Research has shown that perceptions of a caring relationship with a teacher and a positive environment were related to school satisfaction (Baker, 1999). A review of literature indicated that more research is needed to examine alternative interventions that can effectively impact the educational environment of at-risk students (National Center for Educational Statistics, NCES, 2001).

To facilitate the mentorship program, the researcher recruited active members of the National Society for Black Engineers (NSBE). NSBE is the largest student-managed organization in the country. With over 2000 elected leadership positions, 12 regional conferences and an annual convention, NSBE provides opportunities for involvement that rivals that of any other organization (http://www.nsbe.org/). With its established name and reputation, NSBE serves as an exemplar student-based organization in the area of engineering and engineering education. Mentors were purposefully assigned to their respective participants based on adequate time schedules, similar backgrounds, and other salient information gleaned from a student information sheet each prospective NSBE mentor completed.

A simple random sample was used to select study participants. This sample was selected from the population of eighty-three students attending the alternative high school by a process that provided every member an equal opportunity of being selected. The main advantage of randomly selected samples is that it yields information that can be generalized to a larger population within margins of error which can be determined by statistical formulas (Gay & Airasian, 2000). A list was generated that numbered all students from the alternative high school from 1 to 83. To provide a treatment group for this study, a computer software program was used to generate a random list of which the first twenty-one students of African descent generated in the random sorting were chosen as the treatment group for the mentorship program. To provide a control group for the study, the next twenty-one students of African descent in the random sorting were chosen as the control group for the study in descending order. The control group did not receive any mentoring during the program. Of the twenty-one students selected to be in the treatment group for the mentorship program, only fifteen provided parental consent and minor assent allowing them to participate in the program. The control group was reduced to this number to match the number of students participating in the mentorship program. It is suggested that equal group size is required to account for mean variances among groups (Weinberg & Goldberg, 1990). Student participants were allowed to be a part of the study only after securing parental consent from a parent or legal guardian and providing minor assent.

Instrumentation

The survey instrument used in the study was designed using information based on literature related to perceptions of engineering disciplines and self efficacy in the areas of mathematics and science. A review of literature revealed a lack of existing instruments that could sufficiently answer the research questions framing this study. Articles and numerous publications from peer-reviewed journals describing the use and development of various instruments were reviewed. Instruments developed by the New Traditions Project (http://newtraditions.chem.wisc.edu/) and Marat's (2005) study entitled *Assessing Mathematics Self-efficacy of Diverse Students from Secondary Schools in Auckland* provided the basis for an instrument that could effectively measure perceptions and self-efficacy related to science and math. The New Traditions Project is one of five systemic chemistry curricular reform projects funded by the National Science Foundation (NSF). The mission of this project is to "optimize" opportunities for all students to learn chemistry (http://newtraditions.chem.wisc.edu/). The format of the instrument used in this study closely resembles the evaluation survey created by The New Traditions Project. Marat (2005) developed an instrument that measured mathematics self-efficacy for students learning in a multicultural environment of which the results are provided in *Assessing Mathematics Self-efficacy of Diverse Students from Secondary Schools in Auckland*. Using existing questionnaires and literature that examined the intended constructs, an instrument was drafted. This instrument, according to face validation, measured the desired constructs that framed this particular study.

To ensure validity and reliability of the scale items, a panel of five experienced engineer and technology educators from Purdue University, North Carolina A&T State University, Duke University, Southern Illinois University, and Robert

Morris University, reviewed the scale used in the study and provided feedback regarding clarity of questions and their relevance to the constructs being examined. To test the validity of the instrument and ensure that the instrument was measuring the desired constructs, the researcher had the survey reviewed for validity and after careful consideration of the feedback provided from the panel of experienced engineer and technology educators, the scale was revised and reviewed again. The final form only achieved approval after the researcher's panel of experts was satisfied with the revisions and consensus had been reached.

The reliability of the test was evaluated using Cronbach's alpha statistic. Stability, based on test-retest, indicates the degree to which scores on the same instrument are consistent over time. To evaluate the reliability coefficient the scores of the pilot test were correlated. To achieve test-retest form reliability the researcher sought to achieve a coefficient of r = .80 or better (Crocker & Algina, 1986). The reliability of the instrument was verified through a pilot test. As recommended by Borg and Gall (1989), the results of the pilot test were used in order to determine Cronbach's alpha for inter-item reliability. For the purpose of this study a coefficient rate of r = .80 was deemed adequate to establish inter-item reliability. Preliminary analysis of the results revealed that Cronbach's alpha had not reached the desired degree of r = .80. Three particular items were determined to be problematic and their "alpha if item removed" produced scores within the desired rating of r = .80. The exclusion of three items from the instrument (item 2, item 7 and item 16) produced a rating of r = .81. These items were not highly correlated within their intended construct and further examination revealed problems with the items which could potentially impact the reliability of score-based inferences.

The final instrument consisted of 43 closed-ended questions, using a four-point Likert-type scale response with a range of Strongly disagree=1, Disagree=2, Agree=3, Strongly agree= 4. Participants were not asked to put their name on the surveys, thus protecting confidentiality. At the time of the test, participants were notified of their rights related to human subjects' research guidelines. Demographic information of the participants was collected at the beginning of the survey, only identifying the participant's age (at last birthday), grade level, and respective mentor. The dependent variables were represented by data collected from the posttest survey that students completed after the mentorship program ceased. The survey scores were interpreted to represent students' perceptions of engineering disciplines and self-efficacy in the areas of mathematics and science. The independent variable was set by participation or non-participation in the experimental treatment of the NCETE/NSBE mentorship program.

Instrument Details

Section one of the instrument collected the background information of the participants including; (a) grade level, (b) gender, (c) race, (d) highest level of formal education of participants' parents, and (e) GPA. This section of the instrument contained ten items.

Section two of the respective instrument pertained to participants of the NCETE/NSBE mentorship program. This section collected feedback on the participants' experience in the mentorship program, the program's characteristics, and activities encompassing the mentorship program. This section of the instrument contained twelve items addressing the participants' mentorship experience. The control group, students not participating in the mentorship program, was asked to skip this particular section.

Section three of the instrument dealt with students' perceptions and self-efficacy as it related to engineering. This portion of the survey asked students about their conceptual knowledge of engineering as a field and career. Students were also questioned on their confidence and self-belief to do design and other related tasks of an engineer. This section of the instrument contained seventeen items addressing the desired construct.

Section four of the instrument asked about students' confidence and self-belief to use math to solve technological problems and engineering problems. This section in the instrument contained eight items addressing the desired construct.

Section five of the instrument pertained to students' confidence and self-belief to use their understanding of science to solve technological and engineering problems. This section of the instrument contained nine items addressing the desired construct.

Procedure

Unique to this formal mentorship program was the *career function* which, notwithstanding the *psychological support* that mentors provide, focused the mentor relationship on influencing individual student's perception of a particular field or career (Allen & Day, 2002). A four-point protocol was developed as a general guide for the mentors to use in conducting their sessions. The four-point protocol included (a) a film presentation that was representative of some aspect of engineering as a field and/or profession, (b) a field experience selected by the mentor that offered the protégés some exposure to engineering as a field and/or profession, (c) a design challenge that was culturally relevant to the protégés and offered practical applications of science and mathematics principles, and (d) one-on-one counseling that offered the protégés psychological support in the way of a role model and/or counselor.

A recent review of "best practices" for mentorship programs revealed some overarching themes that framed the structure and facilitation of the mentorship program. Best practices for good mentorship described that good mentoring is determined by the selection of mentors, how mentors and protégés are assigned or matched to each other, how formal or informal the relationship should be, how mentors should be rewarded for the contribution, and where and when mentoring can be found (Hargreaves, & Fullan, 2002). Other factors considered included a nonschool setting for mentoring activities, parent support, and structured activities. It is also recommended facilitation of the mentoring program should include supervision and provision of structured activities and mentors with a background in a helping role (Dubois, Holloway, Valentine, & Cooper, 2002). To address these criteria, mentors were chosen from the NSBE organization; mentors were matched to mentees based on similar interests, future aspirations and availability. Although it was a formal mentorship program, the researcher was careful to incorporate practices of informal mentor relationships into the program. The mentorship program was not able to provide a nonschool setting due to the fact that mentorship was performed during regular school hours. However, parental support was achieved through parental consent and the researcher spoke personally with parents and guardians to answer questions and alleviate any concerns about the mentorship program.

In an effort to inculcate the four-point protocol and "best practices" into the mentors' sessions, two separate dates were scheduled for mentor training as provided by the researcher. The two training sessions lasted one hour and encompassed delineating the roles, responsibilities, and duties of each mentor participating in the mentorship program. Potential mentors who were not able to be present at the first training session on October 29, 2007 were subsequently given an opportunity to complete training on November 20, 2007. Mentors participated in a presentation on current educational practice as it pertains to engineering education and the under-representation of minorities in STEM fields. Mentors were informed that the mentorship program was to address the following concerns; (a) lack of exposure at younger ages, (b) absence of role models, and (c) difference in learning styles. The mentorship program solicited the services of nine mentors to facilitate the program.

Prior to engaging in any activities with the students, mentors were asked to complete extensive training and background checks. In order to receive approval from the mentors' respective university allowing the mentors to work with the students, mentors had to complete the Collaborative Institutional Training Initiative (CITI). The mentors were registered as social behavior researchers for the purpose of this study. Those who successfully completed CITI training visited with the principal at the alternative high school and were given background check forms to be completed. The respective high school conducted background checks on all potential mentors seeking to participate in the mentorship program. Institutional Review Board (IRB) approval was secured from The University of Georgia allowing the researcher to conduct research involving a vulnerable population. The researcher also had to secure IRB approval from the Guilford County School District allowing the mentors to work with the students.

Following completion of mentor training, CITI training, and successful background checks, five mentors were available to participate in the study. Four other potential mentors were not able to participate in the program due to either (a) failing to complete mentor training, (b) failure to complete CITI training,

(c) unsatisfactory reports on their background checks, or (d) truancy. The five mentors selected to participate in this study were all students and were active members in NSBE. There were four male mentors and one female mentor. The mentor group was comprised of one graduate student, one senior, one junior, and two sophomores. The mentors' ages ranged from 18 to 23 years of age. Two of the mentors majored in electrical engineering, one in chemical engineering, one mentor was a computer science major while another double majored in electrical engineering and chemical engineering. Based on data provided from a Student Information Form, mentors were assigned three students each from the randomly selected treatment group.

Mentors were responsible for securing a space where their sessions could appropriately be facilitated. Mentors provided the researcher with their availability schedule and this was forwarded to the principal and administrative assistant at the alternative high school involved in the study. Mentors were asked to sign-out students when working with the students for the session and the mentors were responsible for signing students back in at the end of the session. The mentors were allotted no more than an hour to conduct their mentorship sessions and were scheduled to meet students the second and fourth week of each month. The mentorship program was initiated in February and lasted through May.

At the conclusion of the mentoring program, a posttest survey was administered in the form of a pencil and paper written assessment, which the researcher distributed in person. All respective participants attending the alternative high school were instructed to complete the posttest survey with the researcher providing incentive to ensure full participation from the students. To maintain the reliability of the results the researcher asked that all students take the posttest exam in the same classroom and within three hours of the first administered exam. To ensure confidentiality, identification numbers rather than names were used to distinguish the mentored students from the non-mentored students. Using a binary system, random four digit numbers were provided at the top of the survey ending in either a one or zero. Students who were participants in the mentorship program where given surveys that ended in one and students who were not part of the survey were given surveys that ended in zero. Students were asked to identify their age and grade level in addition to the identification number that they were given.

Results

Descriptive Statistics

Out of the fifteen students selected to participate in the mentorship program only twelve students completed the program. One mentor reported that two of his participants transferred to other high schools during the program. Another mentor reported that one of his participants declined to finish the program *after* agreeing to participate. At the conclusion of the mentorship program, twelve students had participated in the treatment for this study. The fifteen students generated for the control group produced from the random sorting of the alternative high school students was reduced to the first twelve in the list in descending order to represent the control group. A total of twenty-four male students out of the eighty-three alternative high school students were randomly selected to participate in the study.

Twenty-four students participated in the study, however only twenty-one surveys yielded useable data. One student was considered an outlier due to the fact that his ethnicity was determined to be White or Caucasian. Another student did not complete the survey, bringing the total number to twenty-two. Upon further analysis, one participant’s responses were deemed invalid and unreliable. The markings on the paper and pencil test clearly demonstrated that the participant did not complete the survey to the best of his knowledge, which posed a problem to the validity and reliability of the results. Throughout the survey the participant marked the first response on the Likert-scale even if this answer contradicted the previous one. The participant simply marked: Strongly disagree=1 for the entire survey, which in the eyes of the researcher was not indicative of answering the survey to the best of his knowledge. With twenty-one valid entries to compare, the researcher randomly eliminated one participant to ensure an even amount of participants for the control and experiment groups. Again, it is suggested that equal group size is required to account for mean variances among groups (Weinberg & Goldberg, 1990). The total number of useable data resulted in twenty participants (N=20).

The treatment group consisted of ten (n=10) Black/African-American male students. The control group consisted of ten (n=10) Black/African-American male students as well. The grade level breakdown is provided in Table 1 below;

Table 1. Participant Breakdown

Participants	Freshman	Sophomore	Junior	Senior
Control Group n=10	2	2	2	4
Treatment Group n=10	5	3	1	1
Total N=20	7	5	3	5

Data was recorded and analyzed using SPSS (Statistical

Package for the Social Sciences).

Data Analysis

Results of the posttest survey were represented by three separate univariate, single-scale data reports. The constructs being examined for each variable were distinct so the data analysis consisted of analyzing the dependent variables independent of each other. Conclusions were drawn based on these computations, and the researcher used a medium effect size set at 0.5, alpha level set at p=0.05, and a statistical power of 0.7. According to Olejnik (1984) effect size is the “specific minimal relationship or minimal difference in populations means that the investigator believes would be important to detect a practical perspective.” In studies that require a hypothesis testing of sample means, Cohen suggested differences of .2 (small), .5 (medium), and .8 (large) standard deviation (Olejnik, 1984). Due to the relatively small and unique population that the sample was derived from, a medium effect size was deemed appropriate. A sample size of twenty-seven students was needed to achieve a statistical power of .7. However due to the loss of participants, which reduced the total number of participants to twenty (N=20), a post-hoc analysis revealed a final power analysis of .56.

For the purpose of this study, independent *t*-tests were used to determine whether differences between group means were statistically significant. In determining significance, the *t*-test makes adjustments for the fact that the distribution scores for small samples become increasingly different from the normal distribution as sample size becomes smaller (Gay & Airasian, 2003). *T*-tests strategy entails comparing the actual mean difference observed with the difference expected by chance. It reports very little else about the nature of that relationship, however it does reveal whether a significant difference exists between groups.

Inferential Statistics

The first research question sought to determine if there was a significant difference in participants' conceptual perceptions of engineering for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students. An independent sample *t*-test was used to compare the means for responses on items related to this question and determine whether they were statistically significant. For perceptions of engineering, the mean score for the treatment group equaled M= 40.30 and for the control group it was M= 38.40. Standard deviations were SD= 5.72 for the control group and SD= 3.95 for the experimental group. Although the experimental group produced a higher raw mean score than the control group, these results were not statistically significant at an alpha level of .05, *t* (18, .05) =.399.

The second research question sought to determine if there was a significant difference in self-efficacy in the area of mathematics for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students. Using the same analysis techniques as described above, results were provided for participants' self-efficacy in the area of mathematics as it related to engineering. For self-efficacy in mathematics the control group yielded a mean score of M= 23.30 and the treatment group had a mean of M= 22.60. The standard deviation for responses on self-efficacy in mathematics was SD= 3.75 for the control group and SD=3.62 for the treatment group. Though there is a slight difference in the mean scores of the control and treatment group these results failed to reach significance, *t* (18, .05) = .676.

Research question three sought to determine if there was a significant difference in self-efficacy in the area of science for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students. In a comparison of mean scores for students' self-efficacy in science as it related to engineering, an independent sample *t*-test determined that differences between the groups were not statistically significant, t (18, .05)=.220. The treatment group produced a mean score of M= 28.10 and the control group produced a mean score of M= 25.80. The standard deviation for each group equaled SD= 4.12 and SD= 3.96 respectively.

Conclusion

The research findings pertaining to research question one did not produce a significant difference for students' perceptions of engineering. Analyses of the exit interviews conducted with the mentors helped provide answers to many questions that arose regarding the mentorship experience. It was evident that more time may be needed in order to significantly impact students' perceptions and self-efficacy. The relatively short duration of the program and time allotted for each mentoring session appeared to have been inadequate and greatly impacted the ability of the mentorship program to affect change. This result was consistent with the work of Garet et al. (2001) and their recommendation that at least 100 hours were required for reform activities to have an effect.

Findings from the research pertaining to research question two did not detect a difference in group mean scores that reached a level of significance. Upon further investigation into exit interview comments, in addition to time constraints, the lack of set activities posed a problem for the mentors and participants alike. The four-point protocol called for mentors and participants to develop challenges that were deemed "culturally relevant." However, this strategy backfired for many mentors because of some participants' reticence to become more involved in the learning process. The time lost and uncertainty of activities may have contributed to the lack of significant difference found between groups.

Research question three sought to identify if there was a significant difference in self-efficacy in the area of science for students who participated in the NCETE/NSBE mentorship program when compared with non-mentored students. The study did not reveal a significant difference in group mean scores for findings pertaining to research question three. As identified earlier, issues of time constraints and the lack of set activities may have contributed to not finding significant differences on this indicator.

Implications for the Field

Findings from this study provided several implications specifically for African-American males with regard to engineering and other related technical fields. It raised questions about activities designed to diversify technical fields, specifically engineering, and could inform organizations looking to implement formal mentorship programs as a way to impact perceptions and self-efficacy of students. The NCETE/NSBE mentorship program was unique in its structure, facilitation, and unprecedented in the field. The mentorship program developed, including data collection instruments, provides a basis for further research on mentoring and its potential to impact underrepresented populations. The mentorship program developed was unique in that it had a career function *and* a psychological function. While the implementation in this study did not produce significant differences in results, the techniques used and the mentoring procedures could be modified to address areas identified as problematic and additional data collected to determine impact.

Additional findings answered some questions regarding the ineffectiveness of the mentorship program and could be used to inform modifications prior to future research. The qualitative interviews conducted with the mentors provided insight into some of the barriers that likely prevented significant differences. The first area identified where changes should be considered is that of duration of the mentoring experience. In assessing the structural features of the mentorship program, the researcher relied on best practices for "reform" activities. Almost all literature on mentoring and professional development calls for programs that are sustained over time (Garet et al, 2001; Penuel, Barry, Ryoko, & Lawrence, 2007). Practical constraints limited the amount of time available for the treatment in this study, but a longer mentoring experience should be examined to determine potential impact on student perceptions and self efficacy.

Issues that took away from the mentoring time included lack of involvement by the alternative high school staff, and difficulties with gathering the students together in a timely fashion. The omission of set activities also had major implications for this study. The time involved to create culturally relevant activities with the students may have affected the overall impact of the mentoring sessions. Feedback from study participants suggested that providing the mentors with set activities that they could embellish on, would have had a positive impact on the overall mentoring experience. This is consistent with literature on best practices that recommended structured activities be provided to mentees (Hargreave, & Fullan, 2002).

As a researcher, it is important to examine all variables that may impact the results of a study. In relation to this research study, the disproportionate amount of upperclassmen in the control group may help explain the lack of statistical significance. Furthermore, the precision of the instrument used in this study must come under scrutiny. When trying to measure sensitive constructs such as perceptions and self-efficacy it is important to ensure that the instrument used is measuring what it is intended to measure. Further examination of the instrument may be in order to ensure its reliability and that the score-based inferences made from the data collected are valid. It is also worthy to note the small sample size for this study. Of the eighty-three students attending the alternative high school, this study selected twenty-four students to participate in the study of which only 20 provided useable data. Although the sample represented twenty-four percent of the population, sample sizes this small are hard to generalize or make inferences to a larger population or determine differences that are statistically significant.

Future research in this area should allow more time for the mentorship program to properly develop. It was expressed several times by the mentors involved and validated by the research that the three months allotted for this study was inadequate to produce real change. Mentors also suggested extending the time for each session. These two factors are critical to the success of the mentorship program and future research should seek to make needed adjustments in these areas. Furthermore, a similar study should provide further analysis regarding between group differences and within group differences. The final results revealed a disproportionate amount of upper classmen in the control group, which potentially could have implications for total group mean score. Chi-squared analyses could be utilized to discern if students' grade levels have any correlation with students' perceptions and self efficacy. Multiple-regression is another statistical approach that could be utilized to provide further analysis of the results. This procedure could be utilized to determine if the completion or lack thereof of each point on the protocol has any impact on the outcomes. This would help reveal if a particular point in the protocol is effective or ineffective. If procedures were repeated with larger control and treatment groups, these types of analyses would be feasible.

The most vital contribution of this research was the formal mentorship model developed including techniques for training mentors, identifying mentor requirements, and developing and testing measurement instruments to evaluate mentoring outcomes. This study was instrumental in providing an example which could serve as a model for the evaluation of formal mentorship programs to positively influence perceptions and self-efficacy of students. Although the survey failed to reveal a difference in mean score that was statistically significant, the study made inroads by establishing a model for comparing the self-efficacy of students participating in a formal mentorship program against those not participating. This data is pertinent to the implications of this research study and those wishing to examine the impact of mentorship programs. The qualitative data provided by the mentors allowed recommendations to be formulated for future research.

References

Allen, T.D., & O'Brien, K.E. (2006). Formal mentoring programs and organizational attraction. *Human Resource Development Quarterly, 17*(1), 43-58.

Allen, T.D., & Day, R. (2002). The relationship between career motivation and self-efficacy with protégé career success. *Journal of Vocational Behavior, 64*(1), 72-91.

Baker, J.A. (1999). Teacher-student interaction in urban at-risk classrooms: Differential behavior, relationship quality, and student satisfaction with school. *The Elementary School Journal, 100*(1), 57-70.

Bandura, A., Barbaranelli, C., Vittorio, C., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development, 72* (1), 187-206.

Campbell, D.T., & Stanley, J.C. (1963). *Experimental and quasi-experimental designs for research.* Chicago: Rand McNally.

Campbell-Whatley, G. D., Algozzine, B., & Obiakor, F. (1997). Using mentoring to improve academic programming for African-American male students with mild diabilities. *School Counselor, 5*, 362-367.

Carter, N. (2005, November). *Historical Context of Closing the Achievemnet Gap.* Paper presented at the meeting for Challenges of Closing the Achievement Gap, Athens, GA.

Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory*. Orlando, FL: Holt, Rinehart and Winston.

DuBois, D.L., Holloway, B.E., Valentine, J.C., Cooper, H. (2002). Effectiveness of mentoring programs for youth: A meta-analytic review. *American Journal of Community Psychology 30* (2), 157-197.

Fine, M. (1986). Why urban adolescents drop into and out of public high school. *Teachers College Record, 87*, 393-409.

Gall, M.D., Gall, J.P., & Borg, W.R. (1996). *Educational research: An introduction* (6th ed.). Boston: Pearson Education.

Gay, L.R., & Airasian, P. (2000). *Educational research: Competencies for analysis and application(6th ed).* Columbus, Ohio: Prentice Hall.

Gay, L.R., & Airasian, P. (2003). *Educational research: Competencies for analysis and application (7th ed).* Columbus, Ohio: Prentice Hall.

Garet, M.S., Porter, A.C., Desimore, L., Birman, B.F., & Kwang, S.Y. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Hall, H.R. (2006). *Mentoring young men of color: Meeting the needs of African-American and Latino students.* Oxford: Rowan & Littlefield Education.

Hansman, C.A. (2002). Critical perspectives on mentoring: Trends and issues. *Eric Clearinghouse on Adult, Career, and Vocational Education.*

Hargreaves, A., & Fullan, M. (2000). Mentoring in the new millennium. *Theory Into Practice, 39* (1), 50-56.

Jenkins, L. (1999). The information superhighway, the community college and the real world: Reflections on the impact of technology on reference work. *Community and Junior College Libraries, 8*(2), 45-49.

Jeria, J., & Gene, R.L. (1992). Minority recruitment and retention problems and initiatives in higher education: Implications for technology education. Retrieved March 27, 2006 from *Journal of Technology Education, 4*(1).

Kram, K.E., & Isabella, L.A. (1985). Mentoring alternatives: The roles of peer relationships in career development. *The Academy of Management Journal, 28*(1), 110-132.

Marable, T.D. (1999). The role of student mentors in pre-college engineer program. Retrieved January 27, 2007 from *Peabody Journal of Education, 74*(44).

Marat, D. (2005). Assessing mathematics self-efficacy of diverse students from secondary schools in Auckland: Implications for academic achievement. *Issues in Educational Research*, *15*(1), 37-68. http://www.iier.org.au/iier15/marat.html

Maughan, B.D. (2006). Mentoring among scientists: Building an enduring research and development community. Unpublished raw data.

Merriam, S.B., & Caffarella, R.S. (1999). *Learning in adulthood.* San Francisco: Jossey-Bass Publisher.

Morgan, J. (1996). Reaching out to young black men. Retrieved January 27, 2007 from *Black Issues in Higher Education*, *13*(16), 16-19.

Murray, M., & Owen, M.A. (1991). *Beyond the myths and magic of mentoring: How to facilitate an effective mentoring program.*, San Francisco: Jossey-Bass.

National Center for Education Statistics (2001). *Educational achievement and black-white inequality.* U.S. Department of Education. Retrieved August 28, 2002 from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001061. pp. 31-43.

New Traditions Project (1997). http://newtraditions.chem.wisc.edu/)

Oates, J., Flores, R. & Weishaw, N. (1998). Achieving student success in inner-city schools is possible. *Research in Middle Level Education Quarterly*, *21*(3), 51-62.

Ormund, J.E. (1999). Human learning. Upper Saddle River, NJ: Prentice-Hall.

Penuel, W.R., Barry, J.F., Ryoko, Y., & Lawrence, P.G. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal*, *44*(4), 921-958.

Reddick, R.J. (2006). The gift that keeps giving: Historically black college and university-educated scholars and their mentoring at predominantly white institutions. *Education Foundations, 20*(1-2), 61-84.

U.S. Energy Policy Act. (2006). 109th Congress, 1st Session. Retrieved November 8, 2006, from http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h6pcs.txt.pdf

Van Collie, S.C. (1998). Moving up through mentoring. *Workforce.* ACC Communications Inc.

Weinberg, S.L., & Goldberg, K.P. (1990). *Statistics for the behavioral sciences*. New York: Cambridge University Press.

Werner, E.E. (1986). The concept of risk from a developmental perspective. In B.K. Keogh (Ed.), *Advances in Special Education: 4, Developmental problems in infancy and the preschool years* 27-43. Greenwich, CT: JAI Press.

Wheeler, C. (1996). Unpublished raw data from thesis. Retrieved March 17, 2006 from *Journal of Technology Education* Masterfile database.

Wicklein, R.C. (2006). Five good reasons for engineering design as the focus for technology education. *The Technology Teacher*. *65*(7), 25-29.

Shop Class as Soulcraft: An Inquiry Into the Value of Work
By Crawford, Matthew B., (2009).
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Abstract

Author Crawford argues for the revival of teaching the skills of tool, machine, and material use in the schools. He points to the decline in our knowledge of the artifacts of our culture and the resulting loss of self-determination. The teaching of manual competence has also provided a method of learning that is well suited to many students who are otherwise disenchanted with school.

Review

Those who teach the art and practice of tool, machine, and material use will probably agree with Crawford¹s assertion that real knowledge comes through confrontation with real things. The theme of the importance of manual competence is repeated throughout this book in a variety of ways and with multiple examples based on the author¹s observations and experience.

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Matthew Crawford is a motorcycle mechanic, experienced as an electrician, and has a Ph.D. in philosophy. These facets of his personality are evident in his writing. Having grown up in a communal setting he had early opportunities to work under the guidance of experienced adults as an electrician. He learned many of the intricacies of wiring and the value of the bond among those who engage in the same kind of work. The fraternity of all those who do similar work has remained with him and given has him an identity and appreciation for the work of others who live by the skills they possess and solve the problems that confront them. This has extended beyond electricians to practitioners in other crafts where judgment arises from knowledge, skill, and experience. He often reflects on how this is part of the life of any tool and machine user including those in his present chosen occupation as a motorcycle mechanic. Between his time as an electrician and a mechanic, Crawford earned a Ph.D. from the University of Chicago in History of Political Thought. Therefore he compares the motorcycle repair experience and its physicality and demands for rigor to the protocols of academic publishing and his resulting feelings of professional panic and lack of productivity.

Crawford sets out to speak for what he considers to be an ideal; that is manual competence. He recognizes that today there is little accommodation for this point of view. The decline in tool and machine use has resulted in a more passive and dependent relationship with our material. People buy what they once made, replace or hire an expert to repair rather than fix themselves. And, the expert often will replace an entire system because a minor component no longer functions. He notes that many believe that it is economically and morally irresponsible to educate the young for tasks and jobs that require skills in tool and machine use and knowledge of materials and processes. Such a course will result, it is argued, in obsolete competencies and learners who forego opportunities to engage in more futuristic endeavors.

On one level this book is Crawford's attempt to understand the greater sense of influence, control, and competence that he has doing manual work. He compares this with what is called knowledge work. His experience is that manual work often is more engaging intellectually. For example, there is work that is rule-based, such as preparing a tax return or running a laboratory test. By contrast, the mechanic does not have clearly defined problems like those at the end of the chapter in mathematics. Usually, the first step for the mechanic is finding the problem. When the rules no longer apply, creativity must begin. Often there is misleading information and ambiguous clues about the problem. All of this must be sorted out by a mechanic who is able to draw on a reservoir of hunches and hypotheses formed by personal experience with problems that bear some resemblance to the present situation.

Why has manual work been devalued as a component of education? Many schools no longer have shop classes, agriculture labs and fields, food preparation areas, or classrooms for teaching office skills, having opted for computer literacy or some other more controlled classroom endeavor. There is little honor in our schools for the productive and consumptive competencies that can be developed through engaging with real objects of everyday life. The student who would pursue this learning becomes an outsider in a school that would rather have every student engage exclusively in studies that are thought to produce college readiness. Learning manual skills, broadly speaking, and preparing for college are not necessarily in opposition to each other. But many a student and student's family give in to the social pressure to follow the more abstract curriculum to better prepare to matriculate to a four-year college, or so they think. The dichotomy of blue collar/white collar, manual/mental work does not exist in reality, and the goal of sending every high school graduate off to college while egalitarian is essentially snobbish. Crawford challenges educators to rehabilitate the learning of manual skills as cognitively rich education.

The disappearance of tools from the curriculum of schools is a step toward wider ignorance of the artifacts in our culture. As Crawford sees it, there is more and more hidden from us as the devices that we use do not allow for intelligent inspection. The days of Sears catalogues with blown-up parts diagrams and schematic drawings are long gone. Oftentimes there are warnings about removing covers, fasteners that require specialized tools, or manufacturing methods that lead to destructive disassembly. The components of systems are treated as "black boxes" and become more mysterious and untouchable as they incorporate more and more functions. The components of electronic devices demonstrate this point as they are miniaturized and made more comprehensive. The decline of tool use and technical understanding signals a change in our relationship with our own possessions. In a sense they are not fully ours as we must replace rather than repair and depend on others to maintain proper functioning. Our ability to determine our own course is diminished and we lose actual control over some dimensions of our lives and environment.

With the decline in the teaching of manual skills in the schools, there is also the loss of a form of learning that is well-suited to many students. "Hands on learning" has almost been a battle cry among teachers of the manual arts. But in fact, it is more than manual learning that is involved. Mechanical work is unpredictable in its outcomes. The person who engages in it confronts real things, not contrived exercises in workbooks or computer simulations. There is active problem solving as the person ventures possible solutions, acts on hunches, tries them, assesses results, and often restarts the process having failed to reach an acceptable conclusion the first time. Physical circumstances vary too much to be approached in a formulaic way. With experience, the learner moves from knowing what to knowing how and realizes how wide the gulf is between these two forms of knowledge. The building of expertise provides for fulfillment and builds confidence. Self-identity and creative abilities grow. In gaining expertise the person learns to perceive things that are invisible to the novice.

Crawford contends that this is not necessarily what society wants and that central to capitalism is the partitioning of thinking from doing. There should be those who think, plan, and manage and those who follow the directives of those who have set the course. True craftsmanship is to be rooted out of the workforce so that through scientific management it will be possible to hire persons of smaller caliber. Analysis of complex work is intended to codify knowledge and degrade work to rule following. Those who transform work into simplified schemes have limited understanding of the intricacies of completing a task and less interest in learning from the ones who have intimate knowledge gained through experience. The knowledge work in an organization is to be kept separate from tasks considered to be menial even though knowledge work often is an illusion. Much of corporate knowledge work is not mentally demanding and may even require the suppressing of intelligence. Students in school are prepared for this existence with one-size-fits-all education in which they are expected to sit still for 16 years. Within the educational environment the system rewards the earning of grades and credits rather than the gaining of knowledge. On the job workers are given little information about the purpose of their work and receive little feedback about its impact. Those who labor are suppressed by the threat of having their jobs sent off-shore or otherwise eliminated. Workers are treated as interchangeable parts of a system that they are discouraged from understanding. Routine work is made more acceptable by consumerism and debt. Members of society are induced to consume and therefore the work must be done in order to pay the resulting bills. The media message is that self-fulfillment and freedom can be achieved through consumption. Technology (instrumental technology, as described by Feenberg, 1991) is to be accepted as socially and politically neutral.

Crawford contends that there is a basic morality in the use of tools. One becomes aware of one's own fallibility. He states, for example, that "the carpenter must face the accusation of the level." The mechanic answers to the rider of the motorcycle and assures the safety and performance of the machine. Stochastic art is developed within a community of like practitioners and users. A worker in the crafts knows when a job is done well because of the experience of successful and less satisfactory outcomes. The standards of performance become intrinsic to practice. Activity is directed toward real features of the world. We come to know a hammer by gripping it not by looking at it. To get an intellectual grasp on the world depends on doing things in it and going beyond icons and mental representations.

Commentary

It is possible to dismiss Shop Class as the ranting of an angry man. I hope this is not done because there is merit in sitting back and reviewing choices that we have made as industrial and technology educators. After periods of resistance, some short and some longer, there has been wide acceptance of education in technology that is more computer-based with more simulations and imbedded problems to be solved and less learning through actual engagement with tools, machines, and materials.

A middle school teacher, overseeing the use of a computerized technology instructional system, told me that he knew where students were going to encounter problems and what questions they would ask. This system, popular with the front office, had become much like the computer games students had at home or may have used in other classes during their school day. The emphasis was on having students work on a series of exercises, each with a captivating label and a work station designed by the vendor of the system. Students were expected to complete exercises in order to find answers to the problems built into the system and to turn in workbook pages to verify that they had completed the assignments. The opportunities to confront students with real things and problems with uncertain solutions had been forfeited. The essential role of the teacher was to track the progress of students through the exercises and oversee the logistics of ensuring that each student experienced each work station. It was necessary that no student got too far ahead of other class members and that everyone was kept busy. Significantly, the teacher was bored.

The dynamics of the work world, which most students will face during their adults lives, provides some hints about readying for it. Many jobs are less than intellectually stimulating. The work place may not provide the fulfillment that everyone seeks and it may even be enervating. However, that does not mean schools should prepare drones who passively accept whatever work role falls to them. There is more to being human than working to be a consumer and pay bills. Qualities of self-reliance, self-realization, personal identity, and creativity can be enhanced for application beyond school or job, often in unanticipated situations. Values and habits of conservation can be instilled to contrast with the drumbeat of consumption. The field of choices can be broadened. Complete reliance on others to provide technical skill and knowledge is not a necessity. Individuals with mechanical skills may not identify and solve the problem with every malfunctioning appliance, machine, and device that they own however, they should be better able to analyze, discern when to proceed on their own, and know when to call for help. The continuing process of going through these steps will expand the reserve of knowledge needed to face increasingly more complex problems. Schools can and should provide the start for this to happen.

The most important point of Crawford's book may be the support for diversity in school instruction. There are too few alternatives for learning by students who do not do well in dealing with the abstractions of reading, mathematics, and mental imaging. School for some is mind numbing and disconnected from life, both present and future. Real experiences can reach some students who are disenchanted with the routine of school classrooms. Many students have learned fractions through measuring. The photography darkroom has been an introduction to chemistry for others. And, there is learning in the "shop" that goes beyond particular manual manipulations and the solving of complex problems. Each time a student identifies and solves a problem the base for solving more difficult problems is expanded. This learning may stand on its own or it may contribute to broader understandings. Will time spent in classes dedicated to the learning of technology become lost opportunities to learn things that are more important? For many students the answer is clearly "no." If students feel that the learning processes used in the school do not relate to them they are less likely to engage themselves fully and more likely to be satisfied with going through the motions needed to make it come to an end. The offering of an award or the threat of punishment does not make lasting learning happen. Using real problems and real processes will reach some students who do not respond to the dominant methods of instruction used in schools. There is a distinct place for education that is based on real problems and the processes that must be employed to solve them, but the case must be made. Educators who enjoy the challenge of the search for real knowledge, as Crawford describes it, are well positioned to lead the charge. The challenge is large, but it does not need to be overwhelming.

My son, who gave this book to me, located it in the philosophy section of the bookstore.

References

Feenberg, A. (1991). A Critical Theory of Technology. New York: Oxford University Press.

AT ISSUE

One True Love

George E. Rogers
Purdue University

As a child of the Sixties, my philosophical beliefs have been shaped by a society that was based on both peace and inclusion. As a new professional, one of my first professional relationships was with NAITTE, the National Association for Industrial and Technical Teacher Educators, and its scholarly publication the *Journal of Industrial Teacher Education*. NAITTE leaders were the icons of the field. It was NAITTE leader and *Journal* editor, Frank Pratzner who mentored me through my first *Journal* publication, and its many rewrites. It was because of these NAITTE leaders' passion and dedication to the profession that I came to develop a true appreciation of the benefits of a professional organization such as NAITTE. As a new teacher educator and now as a seasoned veteran, I have said and continue to say that NAITTE is my one true love. That is why the last decade has been very troubling to me as I watched the decline in the association's membership. In discussions with both current and previous NAITTE Executive Committee members, we all shared this same passion for NAITTE and we desperately wanted the association to endure. But that has not been the case.

It is my belief that this decline is based on the changing landscape of education, both in our secondary schools and in the university-based teacher education programs. In order for our association to maintain its leadership, our association must change with the times. The current national emphasis is, and is projected to be in the future, STEM education. That is why the NAITTE Executive Committee brought forward a proposal to change NAITTE to the Association for sTEm Teacher Education (ASTE). Your associational leadership has one true love, and that is our professional association once called NAITT, formally called NAITTE, and now called ASTE. We are attempting all avenues to expand the reach of ASTE and develop a professional passion for your association by a more inclusive group of teacher educators, those involved in STEM teacher education.

This will be the last issue of the *Journal of Industrial Teacher Education*. Beginning with Volume 47, Number 2, the *Journal* will be titled the *Journal of sTEm Teacher Education*. Please join with us, as ASTE moves forward into its 74th year of serving the professional development needs of industrial, technical, technology, and engineering teacher educators, plus a broadening field that includes STEM teacher educators focused on the "T&E" of science and math.

Author

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BITS AND PIECES

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