Student Perceptions of Selected Technology Student Association Activities

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Background and Rationale

Student Organizations

Since the early 1950s, career and technical student organizations (CTSOs) have provided co-curricular activities for career and technical education students in grades 6-12. Currently, ten career and technical organizations are available for students in agriculture, business, family and consumer science, health occupations, marketing, technology education, and trade and industry programs. Each of the CTSOs is recognized by the United States Department of Education as being an integral part of the respective discipline's curriculum (United States Department of Education, 1998). "CTSOs provide a unique mix of instructional programs and activities that provide middle, junior high, secondary, postsecondary, adult, and collegiate students with opportunities for leadership and career development, motivation to learn and achieve, and recognition for effort and progress (Scott & Sarrkees-Wircenski, 2001, p. 265). The opportunities provided by CTSO activities support many learning theories such as constructivism, inquiry based learning, and cooperative learning, to name a few.

The Technology Student Association

The Technology Student Association (TSA), one of ten CTSOs, is the only student organization dedicated exclusively to students enrolled in technology education classes in grades K-12. TSA serves more than 160,000 K-12 students in 2,000 schools in 47 states nationwide. The majority of TSA's membership consists of middle and high school students (Technology Student Association, 2001a). Its mission is to prepare the membership for the challenges of a dynamic world by promoting technological literacy, leadership, and problem solving, resulting in personal growth and opportunity (TSA, 2001b). TSA provides technology education students with the opportunity to develop leadership and problem solving skills through various avenues including student competitions at

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the local, state, and national level. Currently, TSA offers more than 50 middle and high school competitive events representing most areas of technology education, the *Standards for Technological Literacy*, and various leadership skills.

TSA's Educational Value. The effect that TSA has on a student member is often difficult to document. It is only through direct interaction with the student that one is able to record these effects; this in turn limits the amount of research related to the area. Many of the effects and potential effects of TSA often emerge through the study of other areas related to technology education.

The effects of TSA can be noted in the research in areas including program quality, problem-solving, and critical thinking skills. Busby (1999) reported in his study that used Clark's quality indicators for technology education programs in North Carolina (1997), that the only quality indicator for which there was a significant difference between low performing schools and high performing schools was the program's involvement in TSA**.** High performing and low performing schools were defined by the schools overall score on the North Carolina VoCATs test.

Trainer (1996) researched the potential of the national TSA curricular activities to promote student creative problem-solving and critical thinking skills. Her study concluded that all four TSA activities selected for the study were identified as promoting thinking skills. The results of her research also suggested that all of the teachers believed that the activity they evaluated had the potential to promote creative problem-solving and critical thinking skills among students.

According to the promotional materials developed by TSA, the organization's activities can have an effect upon the attitudes, growth, and development of each member. The *TSA Chapter Startup Kit* lists some of the benefits students derive from TSA such as learning from leadership training; developing and increasing individual civic pride, responsibility, and involvement; the opportunity for individual growth, development, and maturation according to one's own interests and abilities; opportunity to gain additional career information and exposure; opportunity to participate in local, state, and national conferences; learning how to share with others; etc. (TSA, 2000, p. 1.9). Although many of the effects are not backed by research studies, they represent the self-perceptions of the Association about its effects. The assumptions made by teachers, state supervisors, and TSA about the effects of participation allow one to ask, is this really how the student members perceive the organization? The statements also provide a premise for studies related to the perception of the TSA and the validity of such assumptions in regards to the student membership's perception of their student organization.

TSA and Standards for Technological Literacy. Technological literacy is defined as the ability to use, manage, understand, and assess technology as represented by standards and benchmarks in the document (ITEA, 2000, p. 242). According to the National Academy of Engineers and the National Research Council, technological literacy encompasses three interdependent dimensions: (1) knowledge; (2) ways of thinking and acting; and (3) capabilities (2002).

Several technology education professionals have identified the contributions of TSA and its relationship to on technological literacy as defined by the Standards for Technological Literacy. According to Wright (2000), "Although STL [Standards for Technological Literacy] is not intended to be a curriculum, it provides the content for what every student should know and be able to in order to be technologically literate. The TSA competitive events complement the twenty standards and are related to the benchmarks" (p. 7). Dugger (2001) added, "TSA has an important role to play in this implementation effort [referring to the Standards for Technological Literacy] (p.7). More recently, Willcox (2003) stated,

> TSA can make a significant contribution toward assisting every student in grades K-12 to become technologically literate by developing cocurricular competitive events that required students to demonstrate their abilities to use, manage, assess, and understand technology. Because of such experiences, student will be able to show evidence of their knowledge and ability to solve simplistic and complex technology-based problems. Students' solutions to such problems/challenges will include the application of mathematics, science, design, engineering, and technology. (p. 7)

Based on the previous studies, as well as affirmations and comments from various professionals, the researcher realized the potential role and perceived roles that TSA can play in developing today's youth. This study provided foundational data to document the beliefs of these professionals by looking at the perceptions of TSA student members. Without such information, TSA is open to criticism and skepticism in regards to its claims about the benefits of membership.

The TECH-know Project

The TECH-know Project is an instructional materials development effort funded by the National Science Foundation (NSF # 0095726) and centered at North Carolina State University. The four year project started in August 2001 with the primary purpose of developing standards-based instructional materials for twenty TSA activities. The TECH-know project represents a significant collaboration between selected state departments, universities, businesses, and TSA. From 2001-2004, more than 140 technology education teachers, technology teacher educators, TSA Curriculum Resource Committee members, and business representatives from across the country, worked together to attempt to develop high quality, standards-based units of instruction based on the *Standards for Technological Literacy, National Science Education Standards, Principles and Standards for School Mathematics*, and TSA activities.

Purpose of the Study

The purpose of this study was to analyze the perceptions of TSA members about selected TSA activities in regard to their effects on skill development and the development of technological literacy. Self-reported measures were designed to assess the effect of the selected activities. These measures examined students' involvement in and preparation for the activity, as well as how this involvement and preparation affected skill development and understandings related to the *Standards for Technological Literacy*. The measures were derived from the *Standards for Technological Literacy*, a review of literature, and the TECH-know Leadership Team.

Method

A survey instrument, *Student Perception of Selected TSA Competitive Events*, developed in 2001 by the TECH-know Project for inquiry and evaluation of its materials and their relationship to TSA, was modified and used as the primary instrument for gathering data related to three research questions.

Research Questions

5. What are the perceptions of the participants regarding their skill development and understandings related to technological literacy?
6. Are there any associations between the participants' involvement in TSA and their perception of skill development and understandings related to technological literacy?
7. Does involvement in selected TSA activities affect one's perception of skill development and understandings related to technological literacy?

The TSA activities included in the study were selected based on their representation and implementation in the TECH-know Project, as well as their perceived ability to reflect all areas of the *Standards for Technological Literacy*. They included the following:

High School Level Activities	**Middle School Level Activities**
Agriculture and Biotechnology Design	Agriculture and Biotechnology Challenge
Desktop Publishing	Cyberspace Pursuit
Film Technology	Digital Photography
Manufacturing Prototype	Dragster Design Challenge
Medical Technology Design	Environmental Challenge
R C Transportation	Flight Challenge
Sci Vis	Mechanical Challenge
Structural Engineering	Medical Technology Challenge
System Control	Structural Challenge
Technology Challenge	Transportation Challenge

The target population for the study consisted of all participants registered for competitive events related to the selected activities at the 2003 National TSA Conference in Orlando, Florida. The number of registrants was obtained from the TSA national office in Reston, Virginia prior to the conference. The sample consisted of those registered participants who checked in for the competition and returned the survey to the Competitive Event Coordinator. The surveys were distributed by TSA to the Competitive Event Coordinators at the 2003 National TSA Conference in Orlando, Florida and then returned to the TECH-know Project for analysis.

Instrument Development

According to Gall, Borg, and Gall (1996), "questionnaires and interviews are used extensively in educational research to collect information that is not directly observable" (p. 289). "Questionnaires have two advantages over interviews for collecting research data: The cost of sampling respondents over a wide geographic area is lower, and the time required to collect the data typically is much less" (Gall, Borg, and Gall, 1996, p. 289). This advantage enabled the researcher to collect the opinion of more than 1100 TSA participants in less than a week at a reasonable expense.

Thomas (2003) noted that surveys are useful for revealing the current status of a target variable within a particular entity. He stated that "the accuracy of the description is enhanced if the variable is expressed in numerical form (frequency, percents, correlation coefficients, etc.) than if the results are reported by means of imprecise verbal expression" (Thomas, 2003, p. 44). Thomas also noted, however, that the numerical presentations of data "fail to describe the qualitative features that make for the uniqueness of each member of collectivity that the survey intended to represent" and is a limitation to the survey approach (Thomas, 2003, p. 44). This argument caused the researcher to employ a mixed quantitative-qualitative methodology which is not discussed in this article due to size limits but focuses on the use of two open ended questions on the survey instrument and TECH-know's student reflection writings to provide triangulation and elaborate on the findings associated with survey data.

The survey instrument titled *Student Perception of Selected TSA Competitive Events,* mentioned earlier, was divided into four sections. Part One gathered background information related to the participants and was developed based on the research and curricular needs of the TECH-know project. This section provided the researcher with an indication of the participants' involvement in TSA and thus was a measure of the independent variables in the study.

Part Two of the instrument measured the students' perceptions of the skills they developed relative to technological literacy. The variables measured were based on the review of literature that included *Technology Student Associations*, the 38th Yearbook of the Council on Technology Teacher Education *(1989), the TSA Chapter Startup Kit,* and the opinions of the TECH-know staff and a panel of experts who reviewed the survey.

Part Three of the instrument focused on the participants' perceptions about their understanding of technological literacy as defined by the *Standards for Technological Literacy.*

Part Four of the instrument focused on the participants' involvement in the activities of the Conference and their perceptions of how their involvement contributed to their academic and personal development. Perceptions were measured using a Likert-type scale consisting of strongly agree, agree, undecided, disagree, and strongly disagree. Two open-ended questions allowed participants to provide additional insights not included in the structured questions.

Pilot Study

To insure validity and reliability, two pilot studies were conducted: one at the state level and one at the national level. The sample for the first pilot study consisted of the participants involved in the twenty selected TSA activities at the 2002 North Carolina Technology Student Association Spring Conference. This conference was chosen because of its size, its location, and the researcher's prior association with it. The second pilot study involved the participants involved in the 2002 Technology Student Association National Conference. This conference was chosen because of its similarity to the actual population involved in the full study.

The instrument was revised as a result of the pilot studies, the input of the TECH-know project staff, and the panel of experts. Most of the procedures used in the pilot study were used in the actual study. However, to ensure a more accurate response set, instruments were distributed to each individual involved in the selected TSA activities rather than to each team, as was done in the first two pilot studies. In addition, in the actual study a cover letter was included to clarify the purpose of the investigation to the participants.

Findings

Data Analysis

Both descriptive and inferential statistics were used to analyze the data from the respondents to the *Student Perception of Selected TSA Competitive Events* instrument. Frequency distributions were used to describe the overall attitudes of the respondents. Pearson's chi-square was then used to determine if there were any associations between respondents' involvement in the TSA activity and their perceptions. Since the data were significantly skewed, the categories of undecided, disagree, and strongly disagree were combined to establish an n greater than 5, enabling Pearson's chi-square to be used. This decision was made based upon the advice of the researcher's advisory committee. A critical value of 18.75 with an alpha of 0.05 was determined appropriate given the size of the study.

The respondents represented both genders, as well as middle and high school level students. Instruments were received from participants for nineteen of the twenty TSA activities, yielding an overall response of 42%. The responses for the individual contests ranged from 0 to 79%.

Average Time Spent in Class Preparing for the Activity

The participants chose one of six different time ranges that best reflected the amount of time they spent preparing for the TSA activity. The data varied for this question relative to the activities. For example, Structural Challenge is an on-site competition where two students build a bridge or tower in a specified amount of time, while Environmental Challenge is more of a community service related competition that requires student to solve and implement an environmental problem of local interest. Given the age of the respondents, time allotments were utilized for this response in the actual study when the pilot study revealed the data were inflated. A category of "none" was also added to accommodate for on-site TSA activities.

Fourteen percent of the participants spent more than 40 hours in class preparing for an activity. Four percent spent between 31 to 40 hours and eight percent spent 21 to 30 hours preparing. Thirty-six percent of the participants spent 1 to 10 hours preparing, while twenty-one percent of the participants did not spend any time in class preparing. Less than two percent did not respond to this question.

Understandings Related to the Standards for Technological Literacy

A series of 12 statements were presented to the participants in order to gain an understanding of what they felt they were learning relative to *Standards for Technological Literacy*. The majority agreed that being involved in their selected activity did increase their understanding of what technology is and how technology works, as defined by these questions (See Table 1). Table 1 also reports that the participants perceived their involvement in the activity increased their understanding of the effects of technology on society and how to solve technology-related problems. Participants perceived that they increased their understanding of how to use the design process and how to solve technology-related problems as a result of being involved in these selected TSA activities.

Participants in the Medical Technology activity felt they increased their understanding the most when compared to participants in other high school level activities regarding what technology is, how technology works, and the effects of technology on society. One could argue that this is due to the investigative nature of the activity and its challenge to the students – "choose a contemporary problem related to medical technology and demonstrate understanding through research, development of a solution, and an effective multimedia presentation" (TSA, 2004, p. 123). Many of the high school level activities utilize design and problem solving techniques as a primary method, thereby

Table 1
Extent of agreement to statements regarding the development of understandings related to the Standards for Technological Literacy.

Statement (*n* = 1138)	**Strongly Agree** % (n)	**Agree** % (n)	**Undecided** % (n)	**Disagree** % (n)	**Strongly Disagree** % (n)	**No Response** n
What technology is	31.8 (358)	41.3 (466)	18.6 (210)	6.7 (75)	1.6 (18)	11
How technology works	35.8 (402)	44.3 (498)	13.8 (155)	4.6 (52)	1.4 (16)	15
The effect of technology on society	41.8 (469)	34.6 (388)	17.3 (194)	4.5 (51)	1.9 (21)	15
How to use the Design Process	45.0 (505)	37.5 (421)	13.4 (150)	2.8 (31)	1.3 (15)	15
How to solve technology related problems	40.6 (455)	41.2 (461)	14.6 (164)	2.9 (33)	0.7 (7)	18

explaining the higher response for the questions related to the participants' perception of increasing their understanding of how to use the design process and solve technology-related problems.

Environmental Challenge participants thought that their challenge of developing a plan then solving an environmental problem of local concern allowed them the opportunity to solve a technology-related problem as well as learning what technology is and how it works. Agriculture and Biotechnology Challenge participants perceived that they increased their understanding of the effects of technology on society as they researched and created displays related to areas of interest in agriculture and biotechnology.

Skill Development

Part Two of the survey addressed the participants' perception of skill development as it pertained to the TSA activity in which they were involved. Table 2 highlights the participants' perception of the skills they developed while participating in the TSA activity. The vast majority of the participants felt that they developed problem solving skills (88.4%) and skills related to learning more about technology. A large proportion (83.2%) felt that they developed teamwork skills while preparing for the TSA activity. Approximately three fourths of the participants felt they developed leadership (76.3%) and math skills (75.7%) while preparing for activities in which they participated. Nearly this proportion (72.2%) felt that they developed science skills while preparing for the activity. Table 2 also shows that nearly all of the participants felt that they developed skills related to working within rules and specifications (93.4%), developed design skills (92.3%), allowed them to be creative (91.9%) and work with their hands (91%). Most (81.6%) believed they developed communication skills while participating in their chosen activity.

Table 2
Extent of agreement to statements regarding the development of skill while participating in the TSA activity.

Statement (*n* = 1138)	**Strongly Agree** % (n)	**Agree** % (n)	**Undecided** % (n)	**Disagree** % (n)	**Strongly Disagree** % (n)	**No Response** % n
Problem Solving	42.6 (481)	45.8(5 17)	9.0 (102)	1.7 (19)	0 (11)	8
Teamwork	51.1 (577)	32.1 (363)	10.1 (114)	3.6 (41)	3.1 (35)	8
Leadership	37.5 (422)	38.8 (436)	16.4 (184)	4.8 (55)	2.5 (28)	13
Ability to use science	34 (385)	38.2 (432)	19.8 (224)	6.2 (70)	1.9 (21)	6
Ability to use math	37.8 (426)	37.9 (427)	15.5 (174)	6.3 (71)	2.5 (28)	12
Ability to learn more about technology	53.4 (600)	35.3 (397)	8.7 (98)	1.7 (19)	0.0 (10)	14
Hands-on Skills	61.0 (687)	30.0 (338)	7.1 (80)	1.2 (14)	0.7 (8)	11
Work within rules and specifications	62.8 (708)	30.6 (345)	5.3 (60)	1 (11)	0.0 (4)	10
Communication Skills	43.7 (493)	37.9 (428)	14.0 (158)	2.7 (31)	1.7 (19)	9
Ability to design	63.8 (720)	28.5 (322)	6.3 (71)	0.9 (10)	0.0 (5)	8
Ability to be creative	65.8 (741)	26.1 (294)	5.8 (65)	1.2 (14)	1.1 (12)	12

General

Part Four of the survey addressed additional areas of interest to the TECH-know project and reviewers. It also highlighted some areas of interest in the research regarding motivation, integration, and career awareness. Nearly 90 percent of the participants believed being involved in the TSA activity motivated them to do their best work. Seventy-two percent of the participants felt that being involved in the TSA activity helped them in their technology class and that it would also help them in their future career. Finally, approximately half of the participants saw the connection to the TSA activities and their mathematics and science classes. Table 3 summarizes the responses.

Table 3
Extent of agreement to general statements relative to participating in the in the TSA activity.

Statement (n = 1138)	**Strongly Agree** % (n)	**Agree** % (n)	**Undecided** % (n)	**Disagree** % (n)	**Strongly Disagree** % (n)	**No Response** % n
Motivated to do my best work	55.9 (609)	31.6 (344)	0.8 (92)	2.2 (24)	1.8 (20)	49
Helped me in technology class	37.9 (415)	34.1(374)	18.2 (200)	6.3 (69)	3.5 (38)	42
Helped me in science class	27.2(298)	28.8 (315)	25.1 (275)	13.8 (151)	5.0 (55)	40
Helped me in math class	21.1 (231)	26.8 (293)	27.6 (302)	17.8 (195)	6.7 (73)	40
Will help me in my future career choice	43.6 (476)	28.1 (307)	20.0 (218)	4.5 (49)	3.8 (42)	46

Part Three of the survey compared the select ITEA/Gallup Poll responses to the TSA participants, but was omitted from this article due to size limitations. It is important to note that even though these descriptive findings shed a positive light on the perceptions of this group of respondents, not all participants agreed to every statement. Factors that could have affected their attitudes include, but are not limited to the requirements and purpose of the TSA activity, time that participant worked on the TSA activity, and/or wording of the question.

Inferential Analysis

In order to address the second research question regarding the associations between the participants' involvement in TSA and their perceptions of skill development and understandings related to technological literacy, Pearson's chi square was utilized. The Pearson's chi-square test compared the observed frequencies in the cells of a contingency table with the values expected from the null hypothesis of independence – H_o: Involvement in the TSA activity has no effect on the student's perception of skill development or understandings related to technology literacy.

According to Agresti and Finlay, "The larger the χ^2 value, the greater the evidence against the null hypothesis test for independence" (Agresti & Finlay, 1997, pg. 255). Since the data were skewed, the first 3 cells (strongly disagree, disagree, and undecided) were combined to assure that the resultant single cell would have an n greater than 5.As noted earlier, an alpha of .05 was established to denote statistical significance. With the six time allotment categories and three categories for participants' perceptions, a critical value of 18.31 was determined by referring to chi-square distribution values for various right-tail probabilities in Agresti & Finlay, 1997, pg. 670. JMP 5 was utilized to compute the Pearson chi-square test for independence for each of the categories.

Twenty eight contingency tables were generated to represent each category in Parts 2, 3, and 4 of the survey by time spent preparing for the TSA activity in class and Pearson chi-square were computed. Significant associations were found for all categories. Table 4 summarizes these findings related to skill development, understandings related to the *Standards for Technological Literacy*, and selected general areas of interest.

Given the significant nature of each association, Bonferroni's test for multiple comparison was then utilized to determine if individual cells were significant. Bonferroni's multiple comparisons allowed the researcher to look within the cells for chi-squared test values that were significantly greater or less than the expected. A critical value of 10.83 and p- value equal to 0.001 was determined to be acceptable after referring to Table C (Agresti & Finlay, 1997) and consulting a statistician who advised the researcher. Twenty three cells were identified that had chi-squared values greater than the critical value therefore suggesting associations between the variables. These cells are summarized in Table 5. The columns are classified by the perception, followed by the category, then the time allotment. Plus and minus signs denote whether the observed frequency was higher or lower than the expected frequency, respectively. Observed frequencies were higher for all but three of the cells identified through Bonferroni's test for multiple comparisons. The cells identified through Bonferroni's approach suggested that those who spend no time preparing for the activity in class disagreed or were undecided in their responses to the various categories. Significant associations were also found between those who strongly agreed to the categories and spent 40+ hours in class preparing for the activities.

Since the associations were found in the corners of the contingency table, the researcher furthered her investigation by asking the third research question, does involvement in selected TSA activities affect one’s perception of skill development and understandings related to technological literacy? Logistic fit was utilized to determine whether one’s perception of skill development and understandings related to the *Standards for Technological Literacy* increased as the participants’ time spent preparing in class increased. The logistic fit was utilized only for the fifteen categories that where identified in Table 5 as significant through Bonferroni's test for multiple comparisons. The fifteen categories are identified in Table 5. For each of the categories, as the time spent in class preparing for the TSA activities increased; the percentage of participants to agree or strongly agree increased.

Table 4
Associations found between various categories and time spent in class.

Associations found between skills developed and time	(Critical Value > 18.31, df =10, alpha = 0.05)
Problem Solving	$X^2(10, N = 1110) = 40.50, p = .0001$
Teamwork	$X^2(10, N = 1110) = 27.18, p = .002$
Leadership	$X^2(10, N = 1107) = 30.85, p = .0006$
Ability to use science	$X^2(10, N = 1112) = 53.81, p = .0001$
Ability to use math	$X^2(10, N = 1106) = 53.82, p = .0001$
Ability to learn more about technology	$X^2(10, N = 1105) = 43.55, p = .0001$
Use of hands-on skills	$X^2(10, N = 1107) = 29.31, p = .001$
Work within rules and specifications	$X^2(10, N = 1108) = 33.65, p = .0002$
Use of communication skills	$X^2(10, N = 1110) = 23.82, p = .008$
Design skills	$X^2(10, N = 1108) = 25.12, p = .005$
Creativity and time spent in class	$X^2(10, N = 1106) = 22.67, p = .01$
Associations found between understandings and time	
What technology is	$X^2(10, N = 1107) = 59.19, p = .0001$
How technology works	$X^2(10, N = 1103) = 45.26, p = .0001$
The effect of technology on society	$X^2(10, N = 1103) = 35.60, p = .0001$
How to solve technology related problems	$X^2(10, N = 1110) = 55.12, p = .0001$
How to use the design process	$X^2(10, N = 1103) = 54.31, p = .0001$
Medical technology	$X^2(10, N = 1099) = 39.69, p = .0001$
Agricultural and Biotechnology	$X^2(10, N = 1092) = 45.12, p = .0001$
Energy and Power	$X^2(10, N = 1094) = 51.80, p = .0001$
Communication technology	$X^2(10, N = 1096) = 34.97, p = .0001$
Construction technology	$X^2(10, N = 1101) = 23.81, p = .0081$
Manufacturing technology	$X^2(10, N = 1097) = 29.41, p = .001$
Transportation technology	$X^2(10, N = 1093) = 51.27, p = .0001$
Associations found between general categories and time	
Helped in technology class	$X^2(10, N = 1080) = 109.97, p = .0001$
Helped in math class	$X^2(10, N = 1078) = 35.95, p = .0001$
Helped in science class	$X^2(10, N = 1079) = 44.13, p = .0001$
Will help in future career choice	$X^2(10, N = 1077) = 41.93, p = .0001$
Motivated me to do my best work	$X^2(10, N = 1074) = 37.80, p = .0001$

Table 5
Associations found through Bonferroni's test for multiple comparisons

Stem	Perception of Respondents	Time Spent In Class	Critical Value
Problem Solving	Strongly Agree	40+ hrs. +	$X^2(1, N = 106) = 14.76, p = .0001.$
Ability to use Math Skills	Strongly Agree	40+ hrs. +	$X^2(1, N = 94) = 12.19, p = .0001.$
Use of Hands-on Skills	Disagree and Undecided	None -	$X^2(1, N = 37) = 12.22, p = .0001.$
Work within Rules and Specifications	Agree	40+ hrs. +	$X^2(1, N = 27) = 12.82, p = .0001.$
Use of Communication Skills	Strongly Agree	40+ hrs. +	$X^2(1, N = 97) = 21.25, p = .0001.$
What technology is	Disagree and Undecided	None+	$X^2(1, N = 92) = 12.30, p = .0001.$
What technology is	Strongly Agree	40+ hrs. +	$X^2(1, N = 80) = 11.71, p = .0001.$
How technology works	Disagree and Undecided	None +	$X^2(1, N = 71) = 12.79, p = .0001.$
How technology works	Strongly Agree	40+ hrs. +	$X^2(1, N = 90) = 12.18, p = .0001.$
The Effect of Technology on Society	Disagree and Undecided	None +	$X^2(1, N = 81) = 11.01, p = .0001.$
How to solve a technology-related problem	Disagree and Undecided	None+	$X^2(1, N = 69) = 15.41, p = .0001.$
How to solve a technology-related problem	Strongly Agree	40+ hrs. +	$X^2(1, N = 102) = 13.95, p = .0001.$
How to use the Design Process	Disagree and Undecided	None+	$X^2(1, N = 66) = 13.60, p = .0001.$
How to use the Design Process	Strongly Agree	40+ hrs. +	$X^2(1, N = 109) = 12.07, p = .0001.$
Energy and Power Technology	Strongly Agree	40+ hrs. +	$X^2(1, N = 67) = 16.05, p = .0001.$
Communication Technology	Strongly Agree	40+ hrs. +	$X^2(1, N = 67) = 13.17, p = .0001.$

Note: Plus and minus signs in the third column denote whether the observed frequency was higher or lower than the expected frequency.

Table 5 ***(continued)***
Associations found through Bonferroni's test for multiple comparisons

Stem	Perception of Respondents	Time Spent In Class	Critical Value
Transportation Technology	Strongly Agree	40+ hrs. +	$X^2(1, N = 76) = 18.06, p = .0001$.
Helped me in Technology class	Disagree and Undecided	None +	$X^2(1, N = 120) = 45.36, p = .0001$.
Helped me in Technology class	Disagree and Undecided	40+ hrs. -	$X^2(1, N = 54) = 13.90, p = .0001$.
Helped me in technology class	Strongly Agree	None -	$X^2(1, N = 19) = 16.53, p = .0001$.
Will help with my future career	Disagree and Undecided	None +	$X^2(1, N = 95) = 12.46, p = .0001$.

Note: Plus and minus signs in the third column denote whether the observed frequency was higher or lower than the expected frequency.

Discussion

Although the results of this study are only reflective of the participants at the 2003 TSA National Conference, they do shed light on the fact that TSA is valued and using TSA activities in the classroom added value to their perception of learning, both in and out of class. The study showed that the more time the participants spent in class preparing for the activities, the more likely they were to have positive perceptions about what they learned from the TSA activities and skills they developed in other areas. The study offers insight to teachers that the use of TSA activities in the classroom benefits students beyond the opportunities to participate in out-of-school competitive events. However, further research is needed to show in detail what is actually learned through the use of these activities both in class and out.

The data showed that most participants felt the activities motivated them to do their best work, helped them in their technology classes, and would help them in their future careers. Approximately half of the participants felt the activity in which they were involved helped them in their mathematics and science classes. Enabling students to become motivated and do their best work provides the opportunity for success in many areas, directly and indirectly. Teachers need to capitalize on these motivational effects. Just how the technology education profession decides to best utilize the opportunities that involvement in TSA provides is open to discussion and further development.

The descriptive data and associations found in this study provide a baseline for further studies related to the effects of TSA activities on skill development, cognitive knowledge, and career choice. The data also provide insights related to the student members and their perception of the organization and its0 potential to encourage the integration of math, science, and technology.

The data generated by this study, based on participants in the 2003 TSA competitive events, provide a base line for further investigations at the local, state, and national levels. The research provides foundational evidence to support the benefits of participation in the Technology Student Association and how it has the potential to enhance the intellectual, technological, and social development of students. Through replication of this study, the door is open to longitudinal studies in the future, something that could not have been done previously. Case studies and additional qualitative research are recommended to give additional depth and meaning. Finally, this study enables comparisons to be made among other career and technical student organizations and in other settings.

Conclusion

Developing technological literacy in today's youth through organizations like TSA offers great potential. It is important to recognize the roles that these organizations play in developing young people. Organizations like TSA should continue to step up to the challenge by documenting and reporting the student successes and the cognitive knowledge gained through involvement in their activities. These organizations should also be recognized for the contributions they provide to many young people. Sincere appreciation is extended the Technology Student Association and the TECH-know project for their willingness to initiate the challenge.

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