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Henry L. (Hal) Harrison II

Philip A. Reed
Old Dominion University

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Comparing High School Students' and Adults' Perceptions of Technology

Henry L. (Hal) Harrison, III
District 5 Schools of Spartanburg County

Philip A. Reed
Old Dominion University

Abstract

This study compared high school student's perceptions of technology and technological literacy to those perceptions of the general public. Additionally, individual student groups were compared statistically to determine significant differences between the groups. The ITEA/Gallup Poll instrument was used to survey high school student's perceptions of technology in the study. The student population in question consisted of three subgroups: students enrolled in a standards-based technology education courses, students enrolled in a Project Lead the Way (PLTW) Principles of Engineering pre-engineering course, and students enrolled in a general education course (language arts, mathematics, or science). In addition, each student group's perceptions of technology were compared to one another to determine differences within each group. Responses from 4 items in the ITEA/Gallup Poll showed descriptive differences between students and adults, and responses from 13 items showed a significant difference between the three student groups. Of those 13 items showing a significant difference between all three groups, 7 of the 13 items showed a significant difference between technology education and PLTW respondents, 6 of the 13 items showed a significant difference between PLTW and general education respondents, and 8 of the 13 items showed a significant difference between technology education and general education group respondents.

Keywords: Project Lead the Way; Technology education

The study of technology in secondary education has received significant attention in the past two decades (NGSS Lead States, 2014; International Technology Education Association [ITEA] 2007; National Assessment Governing Board, 2013; Pearson & Young, 2002). Much attention in the literature, however, has focused on information and communications technology (e.g., Olson, O'Brien, Rogers, & Charness, 2011; Zickuhr & Madden, 2012) with very few studies focusing on broader technological literacy (e.g., Falk & Needham, 2013). Additionally, there is a trend to add engineering design content at the secondary level (NGSS Lead States, 2014).

A variety of pre-engineering courses have been introduced into secondary schools around the nation, and arguably the most popular pre-engineering program being incorporated into schools across the United States is Project Lead the Way (PLTW; McVeary, 2003; Hughes, 2006; Ereckson & Custer, 2008). PLTW was developed in upstate New York in the mid-1990s and funded by an educational endowment. The founding premise was to prepare a curriculum designed to encourage students to become interested in the engineering field and ultimately to increase the numbers of engineers and engineering technicians in the United States (Hughes, 2006). The Division of National Labor Statistics noted the rising need for future engineers as well as the current critical shortage of qualified engineers in the profession (Southern Regional Education Board, 2001). Theoretically, the idea of developing pre-engineering programs to combat these critical issues is natural; however, some scholars feel that other programs, such as technology education, have suffered from the growth of pre-engineering programs around the nation (Rogers, 2006; M. K. Daugherty, personal communication, August 5, 2008). In many states, PLTW and other similar pre-engineering programs are starting to change technology education programs in both middle and high schools, although their scope is narrower than broadly defined technology education programs (Blais & Adelson, 1998).

Technology education programs have served students in the United States by teaching about technological processes that are needed to solve problems and extend human capability (ITEA, 2007). Technology education has changed immensely from industrial arts in the 1980s. Instead of content based on industrial practice (industrial arts) or the natural world (science), technology education studies the human designed world, inclusive of technological systems, processes, and artifacts (not just computers). Many states and organizations now refer to this K–12 discipline as technology and engineering education (Reed, 2014). The push for disciplinary content standards provided the context for the International Technology Education Association (ITEA; now the International Technology and Engineering Educators Association) to publish the *Standards for Technological Literacy: Content for the Study of Technology* (ITEA 2007), which was first published in 2000, and clearly define the discipline of technology education as well as outline the characteristics of a technologically literate individual. ITEA, as well as other advocates including the National Academy of Engineering and the National Research Council, agree that technological literacy is important for all people (Pearson & Young, 2002; Pearson, 2004; Garmire & Pearson, 2006; Daugherty, 2008; Terry, 2008). Although pre-engineering programs are considered a specialized career and technical education (CTE) program, they do have an impact on technology education programs that focus on technological literacy for all (Blais & Adelson, 1998). This study investigated the perceptions of technology in several groups; specifically, high school students taking PLTW courses, students taking technology education courses, general education students, and adults in the United States were studied to aid CTE program areas, the technology education profession, school districts, and other constituents.

Purpose

This study sought to determine if differences existed in perceptions of technology between adults and high school students. Additionally, this study was designed to provide a measurable means of determining the perceptions of technology for high school students enrolled in technology education courses and PLTW courses and for students not currently enrolled in either. The 2001 and 2004 ITEA/Gallup Poll (Rose & Dugger, 2002; Rose, Gallup, Dugger, & Starkweather, 2004), an instrument that measures people's perceptions of technology was administered to students enrolled in PLTW's Principles of Engineering course, students enrolled in the Fundamentals of Technology (now titled Foundations of Technology) course within the state of North Carolina, and a group of students not enrolled in either course. The Principles of Engineering course is a broad introduction to engineering, whereas the Fundamentals of Technology course is a broad technological literacy class based on the *Standards for Technological Literacy* (STL; ITEA, 2007).

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Additionally, this descriptive study allowed the researchers to compare student's understanding and perceptions of technology with adult's perceptions of technology collected from ITEA's 2001 and 2004 Gallup Poll studies (Rose & Dugger, 2002; Rose, Gallup, Dugger, & Starkweather, 2004).

To describe the perceptions of technology in each of the three student groups, the study utilized a demographic questionnaire, the ITEA/Gallup Poll (ITEA, 2001, 2004) instrument and statistical tests to determine significant differences between group means. It should be noted that both the 2001 and 2004 ITEA/Gallup Poll surveys incorporated a 4-point Likert scale for each survey item in order to determine means and perform relevant statistical tests (ITEA, 2001, 2004). The same 4-point scale was used during this study to aid in the investigation of a possible correlation between the prior ITEA (2001, 2004) studies and the populations sampled. Additionally, the students' perceptions of technology were described and related to the courses that they completed.

Methods

Participants for this research study were convenience sampled[1] from the North Carolina Department of Public Instruction's (NCDPI) technology education program and PLTW program database during the 2009–2010 academic year. A convenience sample (n = 10) was drawn from the entire population of North Carolina's Fundamentals of Technology course teachers (N = 125), and a sample (n = 9) was drawn from the entire population of North Carolina's PLTW (N = 35) programs. Additionally, a convenience sample consistent with the number of Fundamentals of Technology courses and PLTW courses was drawn for the study to serve in a reference group capacity. Randomly selected teachers were mailed a cover letter explaining the study to the teachers, parent consent form, student participation form, a reference copy of the survey including specific demographic information, and the ITEA/Gallup Poll (ITEA, 2001, 2004).

A demographic questionnaire and the ITEA/Gallup Poll instrument were used to collect data for this study. The demographic questionnaire was designed to integrate with the ITEA/Gallup Polls (ITEA, 2001, 2004) and collected information concerning each student's gender, ethnicity, general questions about which mathematics and science courses they have taken or are currently enrolled in, a question asking how many technology or engineering related courses that they have taken, and a way to identify which group they were in. The demographic data were used to show similarities and differences among gender, mathematics and science backgrounds, technology or engineering backgrounds, and ethnicity. The combined instrument and demographic questionnaire were redesigned to be used in an online environment so that teachers could take students to a computer laboratory and have them log into the online survey system and complete the survey. All instruments and research methods were approved by the Institutional Review Board at Old Dominion University in Norfolk, Virginia prior to data collection.

Both ITEA/Gallup Polls (ITEA, 2001, 2004) were developed in collaboration with ITEA and the Gallup Organization. The original purpose of the poll was to determine the United States public's perceptions of technology and technological literacy (Rose & Dugger, 2002). It is important to note, however, that the ITEA/Gallup Polls (ITEA, 2001, 2004) are opinion polls that measure perception and general reactions to particular terms, ideas, proposals, or events. The instrument is well grounded in the STL, and several survey items directly reflect STL. Moreover, the polls

[1] Fraenkel and Wallen (2003) define a convenience sample as "a group of individuals who are conveniently available for study" (p. 103).

included a series of questions that focused on technology and technological literacy concepts.

The content validity of the ITEA/Gallup Polls (ITEA, 2001, 2004) have been established through the research of Rose and Dugger (2002) and Rose, Gallup, Dugger, and Starkweather (2004). Both research projects were designed to reveal what Americans think about technology and used STL as a foundation for the construction and validity of the instrument because STL was developed to standardize the concepts taught in the study of technology (ITEA, 2007). Moreover, a majority of STL is incorporated into the instrument design to accurately assess the public's perceptions of technology (W. E. Dugger, Jr., personal communication, November, 20, 2008).

Reliability was evident during the administration of both the 2001 and 2004 ITEA/Gallup Polls. In both studies, telephone-owning households in the United States were selected for the survey, and random digit telephone dialing techniques were used to insure the inclusion of both listed and unlisted numbers. Also, within each household, only one man or woman 18 years or older was surveyed. In both years, the survey was conducted over a 3-month timeframe. After the surveys were collected, it was determined that both studies had 95% confidence that the error attributable to sampling and other random effects could be plus or minus 4% (Rose & Dugger, 2002; Rose, Gallup, Dugger, & Starkweather, 2004). Perhaps the only surprising difference in the administration of both polls was that the 2001 study surveyed 1,000 respondents, whereas the 2004 study surveyed 800 respondents.

Another aspect of instrument reliability that was attained from the ITEA/Gallup Polls (ITEA, 2001, 2004) was through the similar results reported even though there was a 3-year time difference between the 2001 and 2004 polls. The three major conclusions reported from the 2001 poll were almost verbatim to those of the 2004 poll. Both studies had slightly different agendas. For instance, the 2001 poll was designed to explore the public's view of technology, what it is, and its continuing impact on society, whereas the 2004 poll was designed to build on the 2001 study by adding to, reinforcing, and augmenting the understandings gained from the prior study. Even though the 2001 and 2004 polls had differing agendas, the three major conclusions from the 2001 poll were validated and reinforced with data from the 2004 study. In addition, Rose, Gallup, Dugger, and Starkweather (2004) revised the first study's conclusions, incorporating three more conclusions that are justified by the cumulative weight of the two studies.

Findings

Data on adult perceptions of technology were obtained from Rose and Dugger (2002) and Rose, Gallup, Dugger, & Starkweather (2004) and were used to compare to the students' responses. Additionally, comparisons were made between students in the Fundamentals of Technology course, students in the PLTW Principles of Engineering course, and a group of students from a general education course (i.e., language arts, mathematics, or science) who had either not taken or were not currently enrolled in the PLTW or *Fundamentals of Technology* class. Descriptive statistics were used to summarize and compare the data in each group (Ott & Longnecker, 2001), and collected data were compared using chi-square analysis to answer the research questions.

The demographic information collected from each group was synthesized in order to develop commonalities and differences between the student groups. Gender and ethnicity demographics were collected in order to observe differences in perception of technology utilizing these demographics in both mutual and exclusive manners. The general questions addressing the various mathematics, science, and technology or engineering courses that students took aided in determining

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commonalities or differences between each group's enrollment in the various courses and their perceptions of technology. The demographic information collected in this study is reported in summary form to better illustrate the sample.

Of the 29 packets mailed to teachers of all three groups, 15 packets were returned for a response rate of 51.7%. A total of 151 students participated: 58 were enrolled in technology education classes, 23 in Project Lead the Way classes, and 70 enrolled in general education classes. All instruments were deemed usable for the study. Technology education teachers were mailed 10 packets, five of which were returned for a response rate of 50%. Project Lead the Way teachers were mailed nine packets, four were returned for a response rate of 44%. Ten general education teacher packets were mailed with six being returned for a response rate of 66%. Although no demographic instrument item asked respondents to identify their age and grade level, it was assumed that students were of standard high school age and grade level based on their participation in the classes in which they completed the survey. Table 1 illustrates the demographics of respondents by gender and ethnicity.

Table 1
Gender and Ethnicity of Respondents

	Technology education	PLTW	General education
Male	82.8%	82.6%	54.3%
	(48)	(19)	(38)
Female	17.2%	17.4%	45.7%
	(10)	(4)	(32)
African American	19%	8.7%	34.3%
	(11)	(2)	(24)
Asian	0%	13%	5.7%
	(0)	(3)	(4)
Hispanic	5.2%	8.7%	4.3%
	(3)	(2)	(3)
White	69%	69.6%	51.4%
	(40)	(16)	(36)
Other	6.9%	0%	4.3%
	(4)	(0)	(3)

Demographic data from both the 2001 and 2004 editions of the ITEA/Gallup Poll were similar in nature (Rose & Dugger, 2002; Rose, Gallup, Dugger, & Starkweather, 2004). Respondents from both studies were taken from telephone households in the continental United States. One thousand people were surveyed in the 2001 study, and 800 people were surveyed in the 2004 study. Both studies required the respondents to be 18 years of age or older.

The demographics for the 2001 study included 47.9% of the sample being male and 52.1% being female. The age of respondents was divided into three categories, including 18–29, 30–49, and 50 and older. The respondents were 20.7% in the 18–29 age group, 43.5% were in the 30–49 age group, 34.7% were in the 50 and older age group, and 1.1% of the sample chose not to disclose their age. The race demographic was categorized as White, African American or Black, and all others. Eighty-three percent of the sample classified themselves as White, 9.5% as African American or Black, and 6.9% as all others. Finally, the respondents were asked in what region they resided, which was divided into four categories including East, Midwest, South, and West. Of the respondents 22.8 percent listed the East as their region of residence, the Midwest had 23.6%, the South at 31.2%, and the West at 22.4% (Rose & Dugger, 2002).

The demographic data for the 2004 study was comprised of 48.6% male and 51.4% female respondents. The age demographic in the 2004 study had four classifications including: 18–29, 30–49, 50–64, and 65+ age groups. Of the sample, 17.7% was 18–29, 41.7% were 30–49, 23.9% were 50–64, and 15.8% were 65+. Less than one percent (0.9%) chose not to classify themselves within an age group. Similar to the 2001 study, over 80% (80.4%) of the respondents were White, 10.3% African American or Black, and 7.6% were all other. Lastly, the 2004 study's demographics were similar to the 2001 study in regards to categorizing the region of the United States where the respondents resided. Respondents in the East accounted for 22.7% of the sample, the Midwest accounted for 24%, the South accounted for 31.8%, and the West accounted for 21.5% (Rose, Gallup, Dugger, & Starkweather, 2004).

Along with the standard demographic information presented in Table 1, it was decided to identify how many technology or engineering courses students from all three groups have taken in the past, not counting the course that they were currently taking. Table 2 illustrates these findings.

Table 2
Technology or Engineering Courses Respondents Have Taken Previously Not Including the Course They Are Currently Taking

Technology or engineering course	0	1	2	3 or more
Technology education (*n* = 58)	20.7% (12)	27.6% (16)	34.5% (20)	17.2% (10)
PLTW (*n* = 23)	26.1% (6)	26.1% (6)	30.4% (7)	17.4% (4)
General education (*n* = 70)	27.1% (19)	24.3% (17)	24.3% (17)	24.3% (17)

It is interesting to note that for the technology education and PLTW groups, over 34% and 30%, respectively, of the students have had two technology or engineering courses prior to the course in which they were currently enrolled. Another interesting finding was the near even distribution of general education students between each of the four selections. Of the 70 general education student respondents, 19 students noted that they had never taken a technology or engineering class. In the remaining categories (1, 2, and 3 or more), the distribution of students was equal (17).

It was also determined that as part of the instrument's demographic information, it would be interesting to identify what mathematics and science courses the respondents had taken or were currently taking. Table 3 illustrates the mathematics courses that the respondents had taken or were currently taking, and Table 4 illustrates the science courses that the respondents had taken or were currently taking.

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Table 3
Mathematics Courses Respondents Were Currently Enrolled in or Had Taken Previously

Group	Algebra 1	Algebra 2	Geometry	Pre-Calculus	Calculus
Technology education (*n* = 58)	100%	50%	60.3%	15.5%	1.7%
	(58)	(29)	(35)	(9)	(1)
PLTW (*n* = 23)	95.7%	73.9%	91.3%	34.8%	8.7%
	(22)	(17)	(21)	(8)	(2)
General education (*n* = 70)	98.6%	64.3%	80%	22.9%	5.7%
	(69)	(45)	(56)	(16)	(4)

Table 3 illustrates that in lower level mathematics classes, such as Algebra 1 and Geometry, 60% or greater percentage of students from each of the groups were either currently enrolled in or had taken those courses. In the higher level mathematics classes, however (Algebra 2, Pre-Calculus, Calculus), the groups begin to differentiate. For example, only half (50%) of technology education students had taken or were currently enrolled in an Algebra 2 course, whereas almost two-thirds (64.3%) of general education students and nearly three-fourths (73.9%) of PLTW students had taken or were currently enrolled in an Algebra 2 course. Additionally, over one third of PLTW students (34.8%) had taken Pre-Calculus, whereas only 15.5% and 22.9% of technology education and general education students respectively had taken or were currently taking Pre-Calculus. From the data, it is apparent that PLTW students had a stronger background in higher level mathematics than either of the other student groups in regards to this study's sample. It should be noted that the PLTW and technology education classes are primarily taken during the student's freshman and sophomore years. Due to the apparent variety of mathematics courses that general education students had taken, the general education students as a whole were older than the other student respondents.

Table 4
Science Courses Respondents Were Currently Enrolled in or Had Taken Previously

Group	Physical Science	Biology	Chemistry	Physics
Technology education (*n* = 58)	69%	75.9%	19%	13.8%
	(40)	(44)	(11)	(8)
PLTW (*n* = 23)	65.2%	73.9%	52.2%	26.1%
	(15)	(17)	(12)	(6)
General education (*n* = 70)	61.4%	75.7%	47.1%	14.3%
	(43)	(53)	(33)	(10)

Table 4 illustrates that there was nearly an even distribution between the three student groups in regard to students who had taken or were currently taking both Physical Science and Biology, both of which are considered fundamental science courses. For instance, respectively, 69%, 65.2%, and 61.4% of technology education, PLTW, and general education course student respondents had taken or were currently enrolled in a Physical Science class. Similarly, respectively, 75.9%, 73.9%, and 75.7% of technology education, PLTW, and general education course student respondents had taken or were currently enrolled in a Biology course. In higher level science courses, such as Chemistry and Physics, the PLTW student group has a greater percentage than the other two groups. It should be noted, however, that PLTW (52.2%) and general education (47.1%) students had similar percentages in Chemistry, whereas only 19% of technology education student respondents had taken or were currently enrolled in the course.

Discussion

The 2001 and 2004 editions of the ITEA/Gallup Poll had some very minor differences and, as mentioned earlier, were combined for this study and formatted for an online survey environment. There were 32 items not including the demographic questions, so only the significant findings will be discussed here due to page limitations. Readers are encouraged to review Rose and Dugger (2002) and Rose, Gallup, Dugger, and Starkweather (2004) for a complete list of ITEA/Gallup Poll items.

Differences Between Students and Adults

After descriptively analyzing the differences and similarities between the students surveyed in this study and the adults surveyed in the 2001 and 2004 editions of the ITEA/Gallup Poll, very few differences were revealed between the groups. However, responses from Items 18, 19, 22a, and 32 showed descriptive differences between students and adults. These items are reported below with an explanation of why the differences may exist between the two groups.

Item 18 asked respondents to determine whether the United States should bring in technologically literate people from other countries or take steps through our schools to increase the number of technologically literate people in our country when a shortage of qualified people occurs in a particular area of technology. Ninety-three percent of adults believed that the United States should take steps in our schools to increase the number of technologically literate people as compared to only 70.9% of students. Perhaps the discrepancy between the student and adult groups was due with the fact that students are currently in school and believe they may have to take courses which help them to become technologically literate and do not foresee the possible negative implications of bringing in technologically literate people from other countries to solve our country's technological problems.

Item 19 defined technology as "modifying our natural world to meet human needs" and asked respondents if they believed the study of technology based on this definition should be included in school's curriculum. Ninety-seven percent of adults and 86.8% of students believed that the study of technology should be included in school curriculum. Although not as varied as the responses of adults and students to Item 18, this differences in responses warrants further investigation. Perhaps the reason for the lower percentage of students responding affirmatively to this item was primarily due to the students currently being in school and believing that they may be susceptible to additional coursework encompassing technology as a subject area if they responded favorably to the item.

Item 22a asked respondents how important it was for schools to prepare students to understand the relationship between science, technology, and mathematics. Ninety-eight percent of adults and 93.1% of students responded that it is either very important or fairly important that schools prepare students to understand the relationship between the three disciplines. This item illustrates that students, even at a relatively young age, understand that these disciplines are not mutually

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exclusive of one another and that the relationship between these disciplines grow stronger as the disciplines continue to evolve.

Item 32 informed respondents that the federal government requires that students be tested in science, mathematics, and reading and asked respondents if these tests should include questions to help determine how much students understand and know about technology. Eighty-eight percent of adults and 57.2% of students believed that questions designed to determine understanding and knowledge of technology should be included in these national assessments. However, this item is similar to Items 18 and 19, which may lead students to believe that if this item was represented in a positive light, students may be required to be evaluated on the concepts of technology. Nearly 60% of the student respondents found it important for the nation to assess student's understanding and knowledge of technology. Likewise, adults greatly see the need to assess technology skills. This is consistent with numerous professional organizations involved in science, mathematics, and technology education (Pearson & Young, 2002; National Assessment Governing Board, 2013).

Differences Between Student Groups

Thirteen of the 66 items in the ITEA/Gallup Poll (ITEA, 2001, 2004) showed a significant difference between students that complete a Project Lead the Way pre-engineering course, students who complete the Fundamentals of Technology standards-based technology education course, and students who are only enrolled in general education courses. Of those 13 items showing a significant difference between all three groups, 7 of the 13 items showed a significant difference between technology education and PLTW respondents, 6 of the 13 items showed a significant difference between PLTW and general education respondents, and 8 of the 13 items showed a significant difference between technology education and general education group respondents.

The technology education and Project Lead the Way student groups had seven survey items that showed a significant difference between the two groups. Of those seven items, Item 9 gave students two definitions and asked them to select which definition they most closely believed was the definition of technology. The technology education students by and large (98.2%) believed that technology, by definition, was the changing of the natural world to satisfy our needs as compared to both of the other student groups who believed technology was just computers and the Internet. This perspective of technology that both the PLTW and general education students believed is a very narrow definition. This narrow definition correlates with both the original ITEA/Gallup Polls (ITEA, 2001, 2004) adult respondents' definition of technology, although organizations such as ITEA, the National Science Foundation, the National Research Council, and the National Academy of Engineering agree with the much broader definition of technology as changing the natural world to satisfy human needs.

The narrow scope of technology (computers and the internet) that PLTW student respondents selected as being the definition of technology may perhaps be the foundation for their responses on several other items. For example, Item 22e asked how important it was for schools to prepare students to have an understanding of the advances and innovations in technology. Perhaps the reason that Item 22e showed a significant difference between the technology education and PLTW student groups dealt with the narrow definition of technology. If the majority of students believed that the definition of technology was simply "computers and the internet", it is not surprising that the students in these groups did not find Item 22e to be as important as the technology education students did because of their perceived definition of technology. Therefore, due to the majority of

PLTW students perceived definition of technology, Item 22e would not seem to be very important to those students because they believe they can learn about the advances and innovations of computers and the internet on their own without formal schooling on the subject matter.

Item 12 gave students two statements ("Don't care how it works as long as it works" and "Would like to know something about how it works") and asked students which of the two statements best described their attitude toward the various forms of technology that they use in everyday life. This item seems to indicate support for broad-based technological literacy because a majority of respondents from technology education (86.2%), PLTW (69.6%), and general education (77.1%) groups stated that they would like to know something about how various forms of technology worked.

Item 13b, which asked respondents whether the results of the use of technology could be both good and bad, alludes to the sociocultural aspect of technology. It is perhaps understandable as to why there was a difference between the technology education and PLTW groups due to the fact that STL Standards 4–7 directly relate technology and society. Because each of the technology education respondents were enrolled in a standards-based technology course, and the fact that 4 of the 20 STL standards address technology and its sociocultural aspects directly, there was a significant difference between the PLTW and the technology education student groups. Although PLTW does incorporate STL into its curriculum, the technology and society standards may either not be addressed or not properly emphasized in its curriculum. Another conclusion is the significant difference between the PLTW and general education student groups because students enrolled in general education courses are not exposed to STL, yet differ significantly between the PLTW student group in believing that the results of the use of technology can be both good and bad.

Another difference between technology education students and PLTW students was illustrated on Item 16a, which asked students whether or not they could explain to a friend how a flashlight worked. A large majority of PLTW (91.3%) and general education (79.7%) students believed that they could indeed explain how a flashlight worked to their peers, whereas only 65.5% of technology education students believed that they could explain the function of flashlight operation to a friend. Perhaps one reason that technology education students may not believe they can adequately explain the function of a flashlight to a friend is due to the concepts they may have learned in their technology course such as: D/C theory, electricity, electronics, and luminescence that are all incorporated into the function of a flashlight. These concepts can often be considered abstract and could also not be incorporated into the technology education curriculum in detail. Technology education students may have realized that in order to truly be able to explain how a flashlight worked to their friends, they would need to know these concepts learned in their technology class thoroughly, and because those concepts were just perhaps introduced to the technology education students, those students may not believe they can adequately explain how a flashlight worked. Likewise, because general education and PLTW students may or may not have studied those specific concepts pertaining to a flashlight and simply believe that flashlights operate by connecting dry-cell batteries, a switch, and a light bulb together in order to complete the circuit.

Item 17e asked students whether or not antibiotics killed both bacteria and viruses. Antibiotics kill only bacteria, but only 25.8% of technology education students and 27.2% of general education students either believed that the statement was either probably false or absolutely false as opposed to 60.8% of PLTW student groups. The fact that just over one in four technology education students believe that antibiotics only kill bacteria could perhaps mean that

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technology education curricula should intensify its instruction on medical technology in standards-based technology education classes. Additionally, as similar percentages suggest based on the sample obtained from the general education students, science courses should place greater emphasis on medical technology. As noted in Table 4, the sample of PLTW students surveyed in this study, as a majority, have taken more advanced science courses than the technology and general education students, which may affect the PLTW group's response to this survey item.

Another conclusion derived from the technology education and PLTW student groups was found in item 22c, which asked how important it was for schools to prepare students to know something about how products are designed. An overwhelming majority (92.4%) of technology education students believed that it was either very important or fairly important for schools to prepare students to know something about how products are designed, as compared to 69.6% PLTW and 76.5% of general education respondents. It is not surprising that a strong majority of technology education students believed that schools should prepare students to know something about how products are designed because that is an enduring concept taught in technology education classes. It was interesting, albeit not statistically significant, that the percentage of students in the general education group was higher than that of the PLTW student group. This is rather interesting because one of PLTW's core competencies is teaching the engineering design process through a variety of means. One would think that students who are enrolled in PLTW courses would as a majority, have a greater belief that schools should teach students about how things are designed than general education students. Although PLTW teaches engineering design as one of its core competencies, PLTW may not include aspects of marketing, product life cycle, and other aspects of product design. Given that the *Next Generation Science Standards* (NGSS Lead States, 2014) emphasize engineering design, secondary students will start to see an increased emphasis on design across subject areas.

This study was designed to assess perceptions of technology and as the literature suggests, there is no one instrument that assesses all three dimensions of technological literacy (Garmire & Pearson, 2006; Petrina & Guo, 2007). However, once a valid technological literacy assessment is developed which assesses all three dimensions, research should be conducted with adults and student groups similar to those utilized for this study. Some organizations such as the Education Testing Service (ETS) are working with the National Assessment of Educational Progress (NAEP) to develop items that assess technological literacy. Curriculum models such as PLTW and Engineering byDesign have developed items specific to their curricula but still assess multiple dimensions of technology and technological literacy. Perhaps these curriculum-specific assessment items could be revised or formulated to fit in the context of large-scale technological literacy assessments such as those ETS is developing with NAEP. Similarly, curriculum programs that focus on technological literacy should partner with NAEP and other professional organizations specializing in the assessment of technological literacy to stress the importance of assessing technological literacy in United States.

References

Blais, R. R., & Adelson, G. I. (1998). Partnerships in education: Project Lead the Way models a program for changing technology education. *Tech Directions*, *58*(4), 40–43.

Daugherty, M. K. (2008). Engineering and technology education. In R. L. Custer & T. L. Ereckson (Eds.), *Engineering and technology education. 57th yearbook of the Council on Technology Teacher Education* (pp. 215–218). Woodland Hills, CA: Glencoe/McGraw Hill.

Ereckson, T. L., & Custer, R. L. (2008). Conceptual foundations: Engineering and technology education. In R. L. Custer & T. L. Ereckson (Eds.), *Engineering and technology education. 57th yearbook of the Council on Technology Teacher Education* (pp. 1–12). Woodland Hills, CA: Glencoe/McGraw Hill.

Falk, J. H., & Needham, M. D. (2013). Factors contributing to adult knowledge of science and technology. *Journal of Research in Science Teaching, 50*(4), 431–452. doi:10.1002/tea.21080

Fraenkel, J. R., & Wallen, N. E. (2003). *How to design and evaluate research in education* (5th ed.). Boston, MA: McGraw Hill.

Garmire, E., & Pearson, G. (Eds.). (2006). *Tech tally: Approaches to assessing technological literacy*. Washington, DC: National Academies Press.

Hughes, E. (2006). Its time has come for you and your schools. *Techniques: Connecting Education and Careers*, *81*(7), 35–39.

International Technology Education Association. (2007). *Standards for technological literacy: Content for the study of technology* (3rd ed.). Reston, VA: Author.

International Technology Education Association. (2001). *International Technology Education Association Technology for all Americans project: Data tables for Gallup Poll on America's level of literacy related to technology*. Reston, VA: Author. Retrieved from http://www.iteea.org/File.aspx?id=50234

International Technology Education Association. (2004). *ITEA public's level of literacy related to technology study*. Reston, VA: Author. Retrieved from http://www.iteea.org/File.aspx?id=50267

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

National Assessment Governing Board. (2013). *Technology and engineering literacy framework for the 2014 National Assessment of Educational Progress*. Washington, DC: Author. Retrieved from https://www.nagb.org/content/nagb/assets/documents/publications/frameworks/technology/2014-technology-framework.pdf

NGSS Lead States. (2013). *The next generation science standards: For states, by states*. Washington, DC: National Academies Press.

Olson, K. E., O'Brien, M. A., Rogers, W. A., & Charness, N. (2011). Diffusion of technology: Frequency of use for younger and older adults. *Ageing International, 36*(1), 123–145. doi:10.1007/s12126-010-9077-9

Ott, R. L., & Longnecker, M. (2001). *An introduction to statistical methods and data analysis* (5th ed.). Pacific Grove, CA: Duxbury/Thomson Learning.

Pearson, G., & Young, A. T. (Eds.). (2002). *Technically speaking: Why all Americans need to know more about technology*. Washington, DC: National Academy Press.

Pearson, G. (2004). Collaboration conundrum. *Journal of Technology Education*, *15*(2), 66–76. Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v15n2/pdf/pearson.pdf

Petrina, S., & Guo, R. X. (2007). Developing a large-scale assessment of technological literacy. In Hoepfl, M., & Lindstrom, M. R. (Eds.). *Assessment of technology education. 56th yearbook of the Council on Technology Teacher Education* (pp. 157–179). Woodland Hills, CA: Glencoe/McGraw Hill.

Reed, P. A. (2014). Standards for Technological Literacy [Public comment on the proposed Virginia secondary engineering teaching license, July 24, 2014 at the Virginia Board of Education]. Retrieved from http://www.doe.virginia.gov/boe/meetings/index.shtml

https://ir.library.illinoisstate.edu/jste/vol51/iss1/4
DOI: http://doi.org/10.30707/JSTE51.1HarrisonII

Rogers, G. E. (2006). The effectiveness of *Project Lead the Way* curricula in developing pre-engineering competencies as perceived by Indiana teachers. *Journal of Technology Education*, *18*(1), 66–78. Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v18n1/pdf/rogers.pdf

Rose, L. C., & Dugger, W. E., Jr. (2002). ITEA/Gallup Poll reveals what Americans think about technology: A report of the survey conducted by the Gallup Organization for the International Technology Education Association. *The Technology Teacher, 61*(6), 1–8 (Insert). Retrieved from http://www.iteaconnect.org/File.aspx?id=49479

Rose, L. C., Gallup, A. M., Dugger, W. E., Jr., & Starkweather, K. N. (2004). The second installment of the ITEA/Gallup Poll and what it reveals as to how Americans think about technology: A report of the second survey by the Gallup Organization for the International Technology Education Association. *The Technology Teacher, 64*(1), 1–12 (Insert). Retrieved from http://iteea.org/File.aspx?id=50140

Southern Regional Education Board. (2001). *High Schools That Work presents a pre-engineering program of study*. Atlanta, GA: Author. Retrieved from http://publications.sreb.org/2001/01V56_Engineering_Web.pdf

Terry, R. E. (2008). Engineering and technology educators working together to promote interest in engineering and technology disciplines in K–12 students. In R. L. Custer & T. L. Ereckson (Eds.), *Engineering and technology education. 57th yearbook of the Council on Technology Teacher Education* (pp. 219–222). Woodland Hills, CA: Glencoe/McGraw Hill.

Zickuhr, K., & Madden, M. (2012). *Older adults and internet use: For the first time, half of adults age 65 and older are online*. Retrieved from http://www.sainetz.at/dokumente/Older_adults_and_internet_use_2012.pdf

Authors

Henry L. (Hal) Harrison, III, is an integrative STEM education consultant and trainer in the upstate of South Carolina and former faculty member in the Eugene T. Moore School of Education at Clemson University. He can be reached at harrisonhal266@gmail.com.

Philip A. Reed is an Associate Professor in the Department of STEM Education and Professional Studies at Old Dominion University in Norfolk, Virginia. He can be reached at preed@odu.edu.