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The *Technology, Engineering, and Design Education Journal*, *Volume XIV,* is the result of the contributions of numerous technology, engineering, and design education professionals. Articles included in the Journal represent the most current research and insights of the technology, engineering, and design teacher education faculty in North Carolina and other states. This volume includes scholarly work completed in 2012. The following authors are recognized for their contributions to this volume:

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Sonya R. Draper, PhD, Barbra F. Mosley, PhD, & Lewis S. Waller, PhD

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Vincent Childress was elected as the Journal's Editor at the NCCTTE 2010, fall conference in Greensboro, North Carolina.

Special Notice

The North Carolina Council on Technology Teacher Education (NCCTTE) has changed its name to the North Carolina Council on Technology, Engineering, and Design Teacher Education (NC-CTEDTE). The *Technology Education Journal*, published from 1990 to 2011, will henceforth be entitled the *Technology, Engineering, and Design Education Journal*, and it will continue the sequence of volume numbers already established.

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Guidelines

The *Technology, Engineering, and Design Education Journal* is a refereed journal published by the North Carolina Council on Technology, Engineering, and Design Teacher Education. The Journal is published on the World Wide Web by the Technology Education program at Appalachian State University in Boone, North Carolina, at http://tec.appstate.edu/technology-education/professional-organizations. The referee process is a blind, peer review process. The Journal also accepts submissions for non-refereed articles. The Journal is not an instructional technology journal. Its focus is primary and secondary school technology, engineering, and design teacher education and primary and secondary school technology, engineering, and design education. Submissions on topics related generally to technology, engineering, and design are welcome *as long as* they are linked to curriculum, instruction, and/or pedagogy *that will inform teacher education*. Manuscripts should follow APA format with the exception of line spacing; single spacing is requested, please. Submissions may be emailed to Vincent Childress at childres@ncat.edu.

Digital Media Infusion in Integrative STEM/Technology Education

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Introduction

Since the first computers appeared in classrooms, teachers have been encouraged to incorporate digital technology in their instruction and assignments. The National Educational Technology Standards for Students (NETS*S), first published in 1998, require students to "publish…employing a variety of digital environments and media." The NETS*S also identify that students need to be able to "analyze [and] evaluate…information from a variety of sources and media" (International Society for Technology in Education, 2011). However, evaluating content from digital media differs from evaluating content from more traditional sources. Digital media, for the purposes of this study, includes electronic photos, video, or audio such as music and sound effects.

The pervasive inclusion of digital media in the sources of information used by consumers every day, particularly on the Internet, has had an impact on how individuals establish the credibility of the information they receive. Eysenbach (2008) found that surface credibility markers, such as a "professional" looking design and the inclusion of pictures, had a large impact on consumers' perceptions of credibility of online health information. He also found that interactive digital media engages people, establishes credibility, and leads to changes in behavior as much or more than traditional media. In a study examining adults' evaluation of online material, graphics and organization/structure were reoccurring characteristics used in evaluating the quality of the site (Rieh, 2002). However, it is not just quantity of digital media infusion, but also the quality of video and audio, that can impact credibility assessment. When incorporating digital media, a "professional design" is regarded more favorably than one that has less professional graphics, such as blinking text or animated graphics (Hilligoss & Rieh, 2008).

Most of these studies focused on content novices evaluating the credibility of digital information, such as lay people evaluating health information online. But how does this change when the evaluator is a content expert? Does an understanding of content mitigate the influence of digital media? One way that educators try to teach credibility assessment to their students is to produce digital media so they see the process of establishing credibility (Flanagin & Metzger, 2008). Do peers who evaluate these kinds of products place more emphasis on content because they have produced a product that infuses digital media? Are educators, who are grading these projects infused with digital media, able to evaluate the evidence of student learning of the content independently of the digital media?

Research Questions

This research study analyzed the relationship among content evaluation, digital media infusion, and overall evaluation of electronic presentations developed by students. The following questions guided this study:

1) Does infusion of digital media tools influence content analysis of experienced Integrative STEM Education evaluators?
2) Is there an identifiable association concerning digital media incorporation and the informative or descriptive nature of an Integrative STEM Education oral/visual proposal?

Calculation of Spearman's rho correlations was used to identify association between the variables of content evaluation score, digital media infusion score, and overall evaluation. Significance was established at the 0.01 level.

Study Participants

The participants in this study were 14 students enrolled in STEM Education Foundations, a 3-credit graduate course in the fall semester of 2011. The students in STEM Education Foundations were selected because they were a knowledgeable audience in several ways for evaluating Integrative STEM Education proposals. First, all the students had completed an initial degree in a STEM (science, technology, engineering, or math) discipline or STEM education discipline, and many had work experience in the discipline or in teaching the discipline. Most had worked as educators; therefore, they are comfortable evaluating student projects. All had completed the content portion of a graduate level course in Integrative STEM Education. Also, all had completed a digital Integrative STEM Education aural/visual proposal; therefore, they are knowledgeable in the format of the proposal and the digital media available to the authors.

The backgrounds of the students in the class represented a mix of STEM disciplines, with at least one student from science education, technology education, engineering education, and mathematics education, although there were more science and math educators than technology and engineering educators. There was an equal number of males and females. For most students, this was their first semester of Integrative STEM Education classes. Not all of the students were pursuing a degree in Integrative STEM Education (see Table 1).

Table 1: Participant demographics

Graduate Degree (# - %)	Gender (# - %)	Semester Enrolled (# - %)
Cert. (2 – 14%)	Male = (7 - 50%)	First (11 – 79%)
M.A.Ed. (5 – 36%)	Female = (7 - 50%)	Second (0 – 0%)
Ed.S. (1 – 7%)		Third (3 – 21%)
Ed.D. (2 – 14%)		Fourth + (0 – 0%)
Ph.D. (4 – 29%)		

Methodology

The STEM Education Foundations class was selected as the participants for the study, because the students could be considered knowledgeable in Integrative STEM Education and had produced an aural/video proposal. This study was conducted during the 15^{th} week of a 16-week semester. During the course of the semester, students addressed topics such as Science Education, Technological Literacy, Establishing K-12 Engineering Education, Mathematics Education Structure and Approach, Unwrapping the Standards, Curricula in STEM Disciplines, and Natural Integration for STEM Disciplines & At-Risk Students. During the course of the semester, each student developed a recorded, audio-only presentation (podcast) related to one of the STEM disciplines. The final project for the course was to develop a seven to 10 minute aural/video presentation to challenge or expand upon an approach or model discussed in class concerning the further promotion and development of Integrative STEM Education. The students were expected to address the nature of the purposeful integration of the STEM disciplines, the academic level at which the model is to be implemented, how buy-in for the model will be created at various levels, and the underpinning research for the model. Students were encouraged to use supplemental audio, images, visualizations, etc. to create a more dynamic and persuasive proposal. The instructor demonstrated one software program (Screencast-O-Matic) that students could use to produce their proposals, but students were not limited to that program.

As part of the normal course procedures, the students were divided randomly into three groups of approximately the same size (two groups of five, one group of four). Each group was asked to review individually the proposals of a different group (e.g., members of Group 1 review the proposals of the Group 2 members). Study participants completed an online survey consisting of three parts. Part A of the survey asked participants to identify which proposals they reviewed and to provide an overall evaluation for each of the proposals on a scale of one to ten. Next, they were asked to respond to an open-ended question about the rationale for their evaluation. Part B of the survey asked participants to read an informational and descriptive piece that identifies example considerations for content analysis of the proposals. Then they were asked to provide a content evaluation of each proposal on a scale of one to 10. In Part C of the survey, participants read an information and descriptive piece that identifies example considerations for evaluation of digital media infusion of the proposals. Participants then provided an evaluation of digital media infusion of each proposal on a scale of one to 10. The research proposal was submitted and received administrative approval by the Institutional Review Board (IRB).

Data and Findings

The study collected data to examine if the infusion of digital media tools influences content analysis of experienced Integrative STEM Education evaluators and if there is an identifiable association concerning digital media incorporation and the informative or descriptive nature of an Integrative STEM Education aural/visual proposal. Figures 1-3 provide a visual account of content score and overall score, digital media infusion score and overall score, and digital media infusion score and content score. The displayed information in all three figures depicts a positive slope between paired sets of data, indicating positive degrees of association (see Figure 1, Figure 2, and Figure 3).

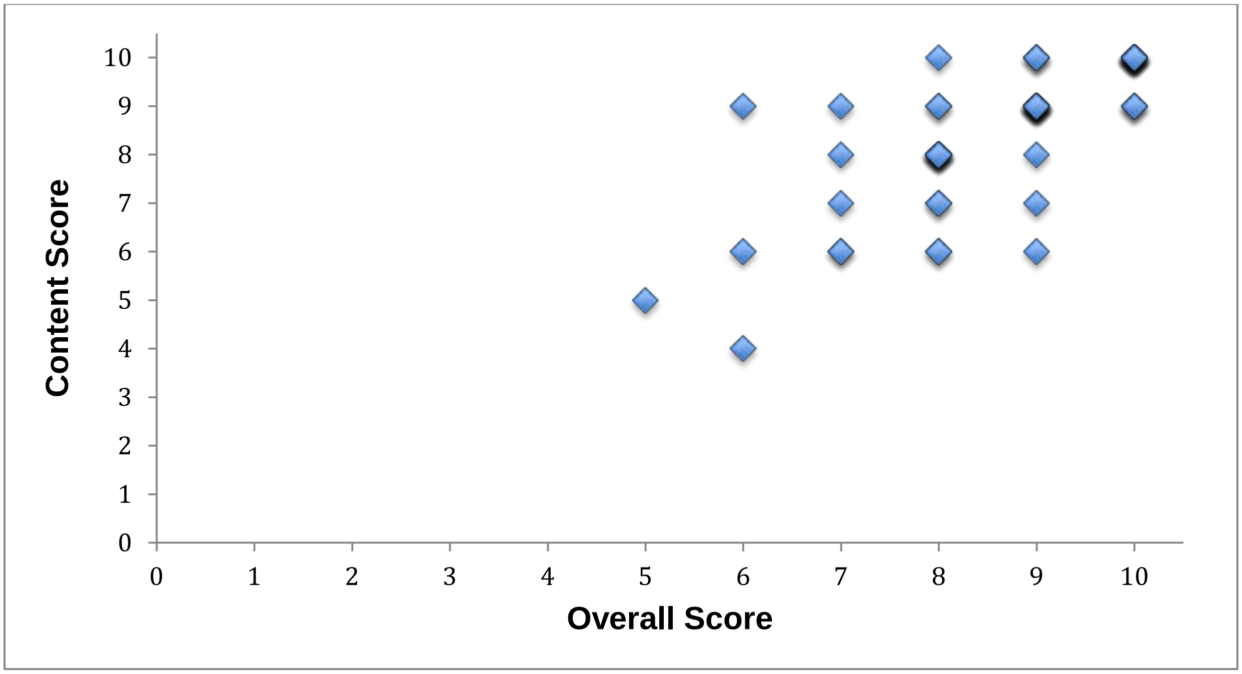

Figure 1: Scatter plot of overall score by content score (n=54)

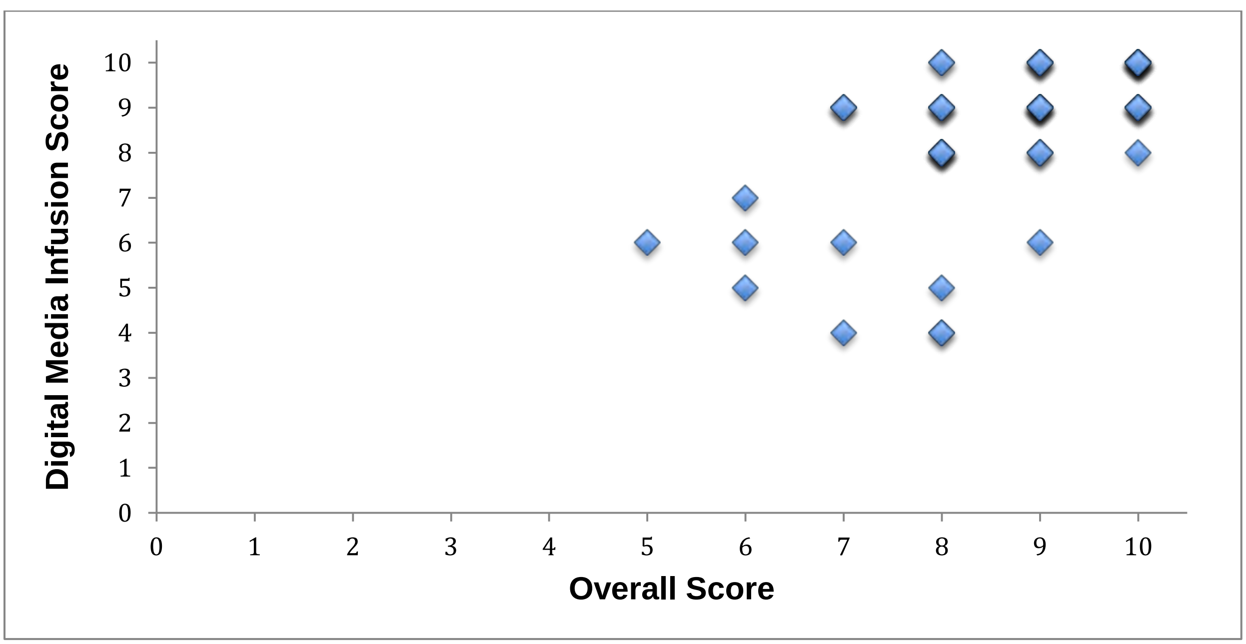

Figure 2: Scatter plot of overall score by digital media infusion score (n=54)

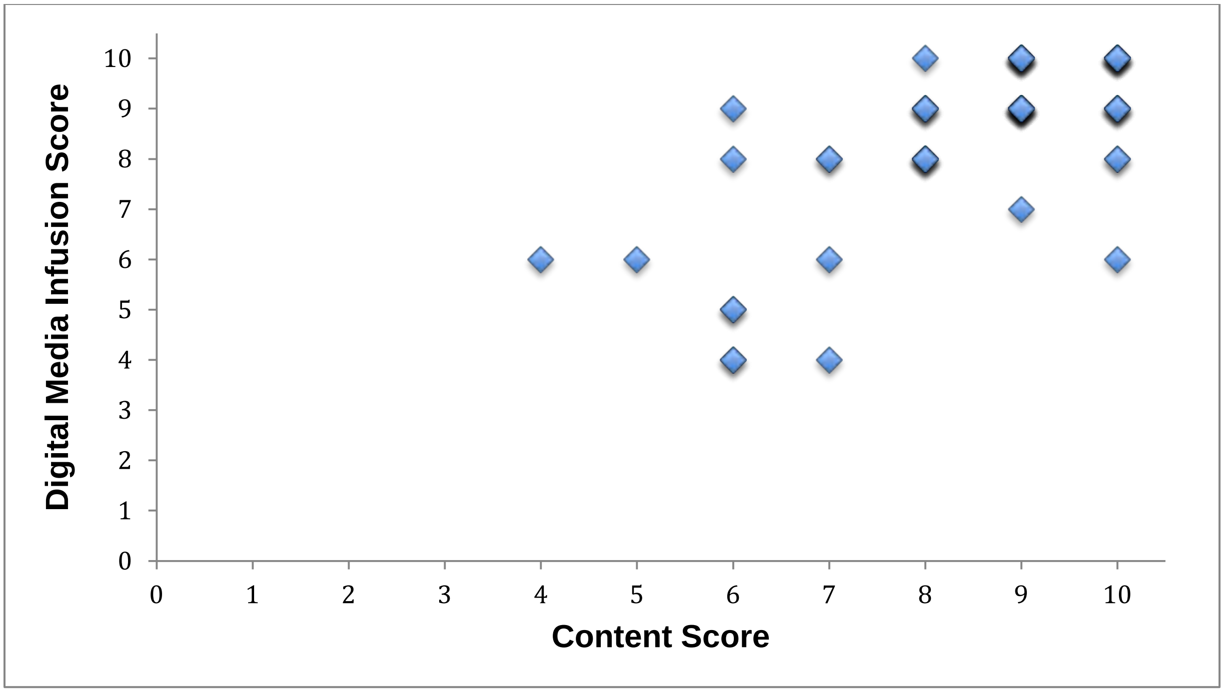

Figure 3: Scatter plot of content score by digital media infusion score (n=54)

Based on the scatterplot visual indicators, the data were analyzed using correlations to identify associations between overall score and content score, overall score and digital media infusion score, and between content score and digital media score. Spearman's rho correlation was selected as the statistical method since the data were not normally distributed.

The Spearman's rho between content score and digital media infusion score is 0.605 (see Table 2). This is significant at the 0.01 level using a two-tailed *t*-test. This indicates a medium, positive association between how an experienced evaluator evaluates content and the infusion of digital media tools. As the digital media infusion increases, evaluation of content has a tendency to increase proportionately.

There is also a medium, positive association between how an experienced evaluator evaluated digital media infusion and the overall evaluation of the proposal. The Spearman's rho between digital media infusion and overall score is 0.592, which is significant at the 0.01 level. As the digital media infusion increases, the overall evaluation of the proposal has a tendency to increase proportionally.

The strongest association is between the content score and the overall score. The Spearman's rho between content score and overall score is 0.754, which is significant at the 0.01 level. Therefore, as the evaluators' score of the content increased, the overall evaluation of the proposal has a tendency to increase proportionally.

These findings suggest that content possesses strong associative features as it relates to overall evaluation where, to a moderate degree, digital media infusion possesses associative features as it relates to content and overall evaluation. Despite the medium positive association between content score and digital media infusion, few participants identified anything related to digital media infusion when asked what factors they used in assigning an overall score. Digital media infusion or elements of digital media infusion such as graphics or background music were not explicitly listed by any of the participants. However, two participants included “interest” or “kept me interested” and one listed “creativity” as factors. These types of factors can be related to digital media infusion, although they could also have a content component. Supporting the stronger association between content score and overall score, most of the factors listed by participants were clearly related to content. Example of content related factors listed are “depth of explanation,” “examples provided,” “feasability,” and “depth of research base.”

Table 2: Spearman's rho Correlation Matrix

	Overall score	Content score	Digital media score
Overall score	--	0.754*	0.592*
Content score	0.754*	--	0.605*
Digital media score	0.592*	0.605*	--

* Correlation is significant at the 0.01 level (2-tailed).

Discussion and Conclusions

The analysis of the data indicated that for knowledgeable Integrative STEM evaluators, content has a greater association with overall evaluation than digital media infusion. This contrasts with earlier studies where novices place more emphasis on digital media components. Analyses of this study sample indicate that being a more knowledgeable evaluator makes it easier to identify the value of the content over the “bells and whistles” of digital media infusion. Because the evaluators of the proposals had also produced a proposal, these findings may support the earlier claim that one way to teach credibility assessment of digital information is to have students produce digital products. However, digital media infusion does have a positive association with both content score and overall evaluation. This suggests that even knowledgeable reviewers are swayed by digital media infusion, although less so than quality content.

As instructors continue to assign projects that have digital media components, it is important to be aware of how the inclusion of digital media can influence the evaluation of the products. The teacher educator needs to pass this awareness on to his or her students so they can address this issue both within their own assessment strategies and as a topic to address explicitly when creating assignments. Further research is needed to identify if rubrics or checklists used in assessment that are weighted more heavily on content characteristics can further minimize the influence of digital media infusion on overall evaluation.

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Youth Technology Program: A Bridge from High School to College Success

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Introduction

A major focus at many universities is the recruitment and retention of their majors. As a result of low enrollments, especially in the science, technology, engineering, and mathematics (STEM) fields, a need has emerged for educators to be proactive and to create initiatives to attract students to these majors. Many institutions have designed different programs to increase the number of students, particularly females and minorities, in these careers. For example, summer camps, Saturday academies, and after-school programs are models utilized to recruit and retain this population of students into technology fields. The need to increase the number of nontraditional students in STEM and related fields is apparent because of data supporting the underrepresentation of women and minorities among professionals in these careers.

Two complementary documents already have set the standard for developing a technologically literate population. The first, *Technology for All Americans: A Rationale and Structure for the Study of Technology* (International Technology Education Association, 1996), provides major tenets to assist educators in helping students become technologically literate and sets the foundation for the second document, *Standards for Technological Literacy* (International Technology Education Association, 2000), which defines what students should know and be able to do in order to be considered technologically literate. The 20 standards that are the focus of the second work delineate proposed outcomes of a technology curriculum in grades K-12; they provide a consistent guide for educators and a framework they can use to develop individualized curricula and programs.

Bridge Programs

To help students learn technology, many programs have been developed at institutions of higher learning. For example, two youth technology camps were offered at North Carolina A&T State University (NC A&T SU) in the School of Technology in the summer of 2008 to increase the number of female students who pursue and succeed in STEM careers (Draper & Blackwell, 2009). The enrichment programs were geared to attract nontraditional students into technology fields in grades six through eight. Another technology camp conducted exposed students, especially females, to the field of technology (Dailey, 1998). Participants in the Technology Day

Camp were middle and high school students who were involved in computer-assisted-drafting, graphic arts, and manufacturing. Students were introduced to technical fields and career opportunities while working in a team environment. Another STEM-related camp conducted in 2008 and 2009 targeted females entering ninth and tenth grade to the field of math (Dave, Blasko, Holliday-Darr, Kremer, Edwards, Lenhardt, & Hido, 2010). The Math Options Summer Camp utilized hands-on, lab-based modules which focused on the usage of technology. The data collected from the workshop evaluations revealed that students enjoyed using technology and gained a broader understanding of STEM careers.

Agricultural education programs are also incorporating innovative technology into their middle school programs. For instance, the Miami-Dade Public School System in South Florida uses computer-based modular instructional technology in its traditional vocational agricultural education program (Alonge, 2001). This emerging trend helps schools adjust to the dynamic agricultural industry environment and attracts the best students into its education programs. Another agricultural camp that integrated technological content into its institute was the Food and Agribusiness Industries Summer Program, which was offered in the summer of 2009 at North Carolina A&T State University in the Department of Agribusiness (Draper & Jefferson-Moore, 2010). This project educated future agribusiness leaders on the logistical transformation of raw agricultural commodities through to the end consumer. It was the first of three cycles funded by the United States Department of Agriculture to provide underrepresented populations of high school students with an opportunity to learn about careers within the food and agribusiness industry. Ultimately, the program's goal was to create a pipeline of students majoring in agribusiness.

Besides summer camps, other technology institutes were being conducted during the school year. One such program was the Saturday Technology Academy (STA) which was offered in the fall of 2010 at North Carolina A&T State University in the Department of Graphic Communication Systems and Technological Studies (Draper & Henke, 2011). The STA was offered for underrepresented populations of high school students in Guilford County, North Carolina. The STA program was designed to increase the number of students who pursue and succeed in STEM careers, by offering a program to students in grades nine through 12. The academy attempted to recruit more females than males into the program. One of the STA's objectives was to provide a pipeline of diverse students participating in STEM school programs.

Figure 1. Final two-color logo created by STA students.

The STA provided a unique opportunity to introduce students to a variety of technology related theory and applications. The graphics portion of the technology academy introduced participants to a creative problem solving strategy useful when designing solutions for graphics-related projects. In this case, students were tasked to develop a two-color logo for the technology institute. The resulting design (see Figure 1) was screen process printed by the participants onto t-shirts.

Another program offered during the school year was Project WISE: Working in Informal Science Education. It was a STEM after-school program that was designed to immerse participants in STEM content (DiLisi, McMillin, & Virostek, 2011). The main focus of Project WISE was to recruit high school-aged women into science education fields. The goals of the project were to: (1) promote young women's interest in science education, and (2) test a recruitment model of how a multi-institutional (liberal arts college, high school, and women's air and space museum) collaboration can build a strong, successful youth program to serve a local community. The premise of the WISE project was to inspire young women to enter STEM careers at an early age (DiLisi, McMillin, & Virostek, 2011).

Youth Technology Program: Phase 1

The importance of serving a community can add value to the quality of a child's education. The 2010 Youth Technology Program (YTP), Phase 1, was one initiative that was created to help students become technologically literate. The YTP was located at North Carolina A&T State University in the School of Technology and offered a two-week summer program for students who had an interest and/or curiosity in exploring technology. The purpose of the YTP was to increase students' awareness in the areas of electronic technology, computer-aided drafting and design, and construction technology. The major objectives of the program were to:

- Promote interest in technology programs through the development of a summer camp by educating high school students about technology careers.
- Help high school students understand technology by engaging them in challenging technology activities to develop their problem solving skills and manipulative skills through hands-on activities.
- Improve high school students' awareness of technology and the role of technology in their lives.
- Develop high school students' ability to communicate effectively in a technological world.
- Create a marketing strategy in order to promote the project and technology programs as vital sources of education, research, and service within the profession of technology.

The target population was high school students with a high emphasis on outreach for girls. The YTP, Phase 1, consisted of high school students (n = 20; 8 females and 12 males).

Phase I tracking. The YTP, Phase1, participants were tracked to determine if they enrolled or planned to major in STEM fields. Data collected from students (n = 14; 5 females and 9 males) indicates:

- 57% of students participating in the YTP planned to major in STEM fields. Of this 57%:
    - 50% were males who planned to major in STEM fields. One college freshman was enrolled in a networking administrator program at Miller-Motte Technical College

(online). Students indicated potential majors as film production, biology, engineering/computer science, graphic design, biology-pre dentistry, and technology.
    - 7% were females who planned to major in STEM fields. One student indicated biomedical engineering as a potential major.
- 36% of the YTP group planned to major in other fields. Of this 36%:
    - 7% were males who planned to major in other fields. One student indicated business/political science as potential majors.
    - 29% were females who planned to major in other fields. One college freshman was enrolled in an animal science major with a science concentration program at North Carolina State University. Students indicated potential majors as education, psychology, and business/economics.
- 93% of the YTP group planned to go to college. No college plans were reported for one individual. Students indicated they planned to attend Howard University, UNC Charlotte, Western Community College, Christopher Newport University, North Carolina A&T State University, UNC Chapel Hill, Miller-Motte Technical College, North Carolina State University, Auburn University, and North Carolina Central University.
- At the time of the YTP's follow-up efforts, 64% of participants were high school seniors, 21% were high school juniors, and 14% were college freshmen.

Thus, all students did not complete the YTP with the intention to enroll in STEM fields, even though they were exposed to technological information. The majority of students planned to attend college. That these students are starting college more technologically literate is a benefit for them and all others concerned. Furthermore, findings indicate that the males in the group are majoring in STEM fields at a higher rate than females. These results show that teachers and other educators must continue to promote such education throughout girls' entire preparatory education from grades K-12 so they may feel they can learn, use, and understand vital content in any STEM setting.

Youth Technology Program: Phase 2

The 2011 Youth Technology Program (YTP), Phase 2, was a one week summer academic and residential experience where high school students explored technology through hands-on and problem-solving activities and team-based projects at North Carolina A&T State University. Goals of the YTP were to improve students' awareness of technology and the role of technology in their lives, and develop their ability to communicate effectively in a technological world.

The YTP, Phase 2, consisted of 14 high school students (8 females and 6 males). Their ages ranged from 14 to 17 years; classifications included sophomores, juniors and seniors. Participants were recruited through an email listing of Career and Technical Education teachers, technology education teachers, guidance counselors, and NC A&T SU's Office of University Outreach Summer Sessions and Certificate Programs website. The YTP provided students an overview of technology principles and engaged them in technology activities. Participants visited laboratories and learned about the many technology programs at North Carolina A&T State University. Faculty coordinated lectures in classroom and laboratory settings, which allowed participants to improve their problem-solving and manipulative skills through hands-on activities.

The YTP, Phase 2, developed students' awareness in the areas of electronic technology, computer aided drafting and design, construction technology, and social media, which was not included in the YTP, Phase 1. On the first day of the program, students were introduced to principles in the construction industry. Topics ranged from how construction meets the needs of society to basic construction techniques. Participants explored various applications in construction technology through hands-on activities. For example, they created a model house using balsa wood strips. Students also gained knowledge of the latest innovations and trends in the construction field, including green building, energy conservation, sustainability, and weatherization. Students who major in this field of study develop skills in engineering and construction as well as in business. In addition, graduates become a vital part of the construction management profession and work on all kinds of projects from highway construction to residential homes.

During the second day of the program, students were given an introduction to AutoCAD software. Participants were taught how to input data into a computer to begin a new drawing and how to dimension and to save drawings electronically. They were also introduced to geometric shapes and how to plot drawings. The professor closed the session with a discussion on careers in the CADD industry. On the third day of the camp, students were given an overview of technology and introduced to electronic components. They drew schematic symbols (battery, transistor, switch, resistor, lamp, inductor, capacitor, etc.) and completed a hands-on electronics lab activity by assembling "The Bug" kit from TeacherGeek.com. Students followed the instruction guide's step-by-step wiring to complete the simple circuit activity.

During the last session, participants were exposed to Web 2.0 tools and free downloadable programs, which included Social Bookmarking, blogs, Google Docs, podcasts, and Windows Movie Maker. The learners used critical thinking and organizational skills to engage in practical activities to enhance their understanding and use of various types of technologies to produce practical products. This session also promoted online collaboration and engagement between the participants. In their everyday lives, students are using a variety of technologies primarily for uses other than work or school (Mosley, Smith-Gratto, & Jones, 2008). Participation in this session allowed students to use the technologies to support school activities and extensions beyond the classroom into future work environments. Understanding how to transfer these skills to work and school helps to prepare these learners for potential STEM related careers.

On the last day of the program, students were asked to rank the sessions from best liked to least liked (i.e., 1 = best, 2 = second best, 3 = third best, and 4 = least liked session). The results of the workshop evaluations revealed:

1st: Construction Technology and Electronics (equally ranked)

2nd: CADD and Social Networking (equally ranked)

The workshop evaluations revealed that participates liked the hands-on, manipulative workshops better than the computer based workshops. Developing students' problem-solving skills and manipulative skills through hands-on activities was one major objective of the YTP program.

Throughout the one-week summer academic and residential experience, high school students learned about careers within the field of technology. During the closing ceremony, which was held on the last day of the YTP, Phase 2, students provided an overview of their experiences. Phase 2 participants will be tracked to determine if they pursue STEM majors.

There is still a need to expose students to STEM content and programs before they select a college major. As educators continue to be more proactive in creating initiatives to attract students to STEM fields, more programs should be targeted and developed for females only. Furthermore, to provide greater results, summer camps, Saturday academies, and after-school programs should be offered in communities with more students, especially girls and in different settings (rural, urban, and inner city). These programs and other innovative models can be devices to effectively promote STEM fields well into the 21st Century.

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