DISSERTATION

TECHNOLOGICAL LITERACY: DESIGN AND TESTING OF AN INSTRUMENT TO MEASURE EIGHTH-GRADE ACHIEVEMENT IN TECHNOLOGY EDUCATION

Submitted by

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In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall, 2007

COLORADO STATE UNIVERSITY

November 1, 2007

WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY MAURICIO CASTILLO, ENTLITLED TECHNOLOGICAL LITERACY: DESIGN AND TESTING OF AN INSTRUMENT TO MEASURE EIGHTH-GRADE ACHIEVEMENT IN TECHNOLOGY EDUCATION BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

TECHNOLOGICAL LITERACY: DESIGN AND TESTING AN INSTRUMENT TO MEASURE EIGHTH-GRADE ACHIEVEMENT IN THE TECHNOLOGY EDUCATION

This study was focused on the design and testing of an assessment instrument to measure eighth-grade student achievement in the study of technology. The instrument measured the impact of instruction in technology education to determine if technology education instruction guided by the Standards for Technological Literacy (STL) can enhance students' technological literacy. The assessment instrument designed to measure technology literacy was reviewed by panel of experts in the field to attain content validity and was pilot-tested before being administered to two groups of eighth-grade students (N=272). The study utilized a two-group post-test only design, a treatment group who had received instruction in technology education in the form a modular instructional delivery classroom and a control group who had not received any formal education in the study of technology. The results of study found that eighth-grade participants taking a technology class performed better (M=15.42, SD=5.42) than those who had no previous technology class exposure (M=14.07, SD=5.25). In comparing the means of the eighth-graders' post-test, there was a significant difference $F\,(1, 270) = 4.40$, $p=.037$, $p<.05$ detected by the instrument designed and tested in this study. The findings in this study suggest that standards-based modular instruction in technology education enhances students technological literacy—an imperative for success in a world that is increasingly dependent on a technologically literate society.

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ACKNOWLEDGMENTS

At the end of each road, there are those individuals that make any project a success. Those individuals were influential during decisive times when I was unable to see the end of the road. Since the beginning of this dissertation, members of my committee were critical towards the completion of this paper. To Dr. Gloeckner, thank you for all of your support and the high standards you set for me, Dr. Feller, thank you for sharing you wisdom, knowledge, and love for the profession, Dr. Folkestad, thank you for your encouragement and motivation. A special thanks to my advisor Dr. Michael A. De Miranda for his support, understanding, friendship, dedication, and patience, “muchas gracias” Dr. D.

Sincere thanks to the De Miranda family for making my family and I feel at home. Special thanks to my family, parents, my brother, my sister, cousins, tios, and tias. To my friends that helped me mentally and physically, I thank you. To the Ceja family and Arauz family, thank you for your support. I would like to thank my wife Rosie, for her loving support and patience during this process. Without her strength and dedication, I would not have been able to do this.

A special thanks to Dr. Don Maurizio for his support and encouragement in completing this milestone. To all the faculty and staff in the School of Education I thank you. To Guadalupe Salazar, Rich Salas and Shirley Guitron in El Centro student services, thank you for making me feel “como en mi casa” at home.

“Prefiero morir parado que morir incado”

Emiliano Zapata

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CHAPTER 1: INTRODUCTION

In the 21st century, the world will depend on individuals with higher levels of technology and science literacy (Standards for Technology Literacy, 2000, p. v) than in the past. Importantly, Daggett (2005), Rose and Gallup (2005), and Feller and Whichard (2005) assert that more students than ever need to be educated to higher levels so that they can compete successfully in a job market that is increasingly dependent on technology. Students should be provided with focused coursework that will prepare them for college and/or provide them with the necessary technical preparation to acquire a job. These demands for higher education and for higher levels of technical skills derive from changes in business environments (Feller and Whichard, 2005).

Technological and scientific literacy is an imperative because of the technological world in which we live (AETL, 2003). For instance, Hoachlander (2006) states that we should use the world of work to engage and motivate students. As a result, students will have more experience with rich and intricate problem solving that requires applying knowledge from diverse ranges of academic disciplines (p. 39).

Science literacy has to do with knowledge of the scientific world. According to Project 2061, sponsored by the American Association for the Advancement of Science (AAAS), science literacy entails being familiar with the natural world and respecting its unity, as well as being aware of some of the important ways in which mathematics, technology, and science depend upon one another (1989, p. xvii). Technological literacy refers to the ability of a person to use, manage, and understand technology. The International Technology Education Association (ITEA) defines technological literacy as "the ability to use, manage, assess, and understand technology" (p. 9). In this study, technology refers to the modification of the natural environmental in order to satisfy perceived human needs and wants (Standards for Technological Literacy, 2000, p. 7). The definition of technology does not refer specifically to computers or the use of computers.

The public school subject intended to impart technological literacy is technology education. Technology education is a subject designed to develop a level of technological literacy in students as it teaches students in grades K- 12. Gordon (2003) asserts that the introduction of technological courses allows students to develop basic skills, thinking skills, and personal qualities. In technology education, learning is brought to life through hands-on learning experiences in laboratory environments (California Department of Education, 2006). Over time, technology education has evolved from its origin in industrial arts, which focused on human productive practices, to technology education, where the focus is on technological literacy (Starkweather, 1986). The purpose of technology education is to prepare students for lasting success in the technological world (ITEA, 2000). With national and state school reform efforts focused on academic achievement, and with the fastest-growing occupations now requiring some postsecondary education, technology education is seeking effective ways to contribute to these goals.

Links to Research

Literature on cognitive-based approaches to teaching and learning has identified how the integration of technology education improves students' academic achievement and their success in future careers (De Miranda, 2004). The literature review will elaborate on this issue by examining the chronological development of cognitively-based approaches to teaching and learning, specifically in cognition science and technology education, and describing how these approaches have evolved to impact students' understanding of technology and link school subjects to future academic success.

Recent Research in Technology Education

The literature suggests that when technology is integrated with other curriculums, there is a correlation to students' performance and understanding, although not always positive. The literature has shown a positive, neutral, or even a negative impact on how the integration of technology affects teaching, learning style, and achievement (Childress, 1994, Hilton, 2003, Shumway, 1999). Studies conducted from 1994 to 2003 investigated how the integration of technology education has facilitated student learning styles and their ability to connect contextual applications in academic courses.

In 1994, a study by Vincent Childress investigated the effects of technology education, science, and mathematics (TSM) curriculum integration on the technological problem-solving ability of eighth-grade technology education students. The study used a quasi-experimental, nonequivalent control group design to compare the performance of students receiving correlated TSM integration to those not receiving integration in an adapted Technology, Science, and Mathematics coursework. The study suggested that there were no significant differences in problem-solving ability between the groups prior to the administration the treatment for the particular technology, science, and math problems.

The Shumway (1999) study compared the effects of cooperative-cooperative and cooperative-competitive classroom goal structures on group problem-solving performance and students' attitudes toward the learning environment within the context of a problem-solving activity in a high school technology education laboratory. A post-test questionnaire was used to collect information concerning student attitudes toward their learning environment and a time measurement used to measure group problem-solving performance. Students participating in the cooperative-cooperative environment generally expressed more positive attitudes toward various aspects of their learning environment than students participating in the cooperative-competitive environment.

Another study conducted by Hilton (2003) investigated if students engaged in integrated technology, mathematics, and science education curricula taught by a technology education teacher would have an increased cognitive learning effect as compared to high school students not receiving an integrated curriculum in technology, mathematics, and science education. The study used a quantitative analysis method, including a multiple linear path analysis, using final course grades as the ultimate exogenous variable. Hilton (2003) stated that school-age children across the country did not use the computer at home for such higher-order cognitive activities and pointed out that while technology training for teachers increased their use of the computer for instruction, students' final science course grades did not improve.

Although Shumway (1999) found that students participating in the cooperative-cooperative environment generally expressed more positive attitudes toward various aspects of their learning environment compared with students participating in the cooperative-competitive environment, the other studies cited above found that the integration of technology with math and science basically had no impact on the problem-solving abilities of the students studied. Through classroom experiences and refinement of instructional methods by trial and error, technology educators have witnessed some success (academic improvement) using hands-on, lab-based design and problem-solving instruction, but these advances have not been documented. Indeed, De Miranda (2004) found that technology educators have long witnessed the success of hands-on, lab-based design and problem-solving instruction but lack a strong connection between well-researched theories on learning and instruction (p. 64).

Concerns in Technology Education

Most of the studies reviewed concentrated on areas of instruction, integration, and student achievement. Increasingly, technology educators will need to provide resources that will give the teachers, faculty, parents, and students a clear vision and comprehensive understanding of the impact that technology education instruction has on academic learning and technology concepts that equate to an enhanced level of technological literacy.

However, in recent years, the technology education curriculum has evolved away from the rich tradition of hands-on, team-oriented, project-based learning commonly associated with activities in industrial arts. Feller and Whichard (2005) claim that there is movement in the field of technology education toward a focus on mechanistic matching of people to a list of existing career choices (p. 15).

The emerging discipline of technology education needs to focus on current cognitive research by seizing the opportunity to illustrate the significance and importance of its programs and instructional methods. Therefore, technology education instruction must continue to focus on the process of *learning* in doing rather than just doing. Such attention could validate student experiences and support teachers' instructional methods.

De Miranda points out that research grounded in theories of the cognitive sciences may provide technology educators with a strong understanding and foundation in support of their experiences. According to Brown (1992), technology students as well as other traditional students must be active learners, be able to participate in data collection, analysis procedures, collaborative participation, and be free to forecast and make inquiries about experimental outcomes.

The curriculum of technology education has evolved from a healthy tradition of hands-on, team-oriented, project-based learning commonly associated with activities in industrial arts (doing). Not surprisingly, these teaching methods have been publicized as the strong point of technology programs for years. According to Sirotnik and Soder (1999), although cognitive science research has provided evidence to sustain the validity of this claim, technology education instructors continue to focus on anecdotal evidence.

Spector and Anderson (2000) argued that these foundations of cognitively based models hold three elements of learning which emphasize engagement, student reflection, and communal interaction and are well defined and supported in technology education through student design activities, production of artifacts, problem solving, and project-based activities. It is important that in the field of technology education this connection is made and recognized for its significance relative to teaching. For instance, students often are limited to simply demonstrating a low level of understanding of the curricula because often, the curricula has emphasized memorization rather than understanding, applying, evaluating, synthesizing, and predicting.

The focus of this study is to create a self-made instrument and measure the level of technological literacy in eighth-grade middle school students who have completed a technology education course. The researcher will test if instruction in technology education is making the student more technologically literate. At the same time, the researcher will assess and compare the level of academic achievement between those students who took a technology education course during eighth-grade with those students who did not take a technology education course.

Statement of the Problem

Technology education has influenced the development of general education since its origins from manual arts training, to what is now known as career and technical education. In the year 2000, the International Technology Education Association introduced Standards for Technological Literacy (STL) (ITEA, 2000). To date, no clear methods for measuring and assessing student attainment in these standards has been instituted. It is the interaction of instruction in technology education and its influence on student learning that is the central problem addressed by this research. More importantly, it is the need within the technology education field to have a reliable and valid assessment tool to measure student learning in the study of technology. This problem is further compounded by the breadth and depth of the current national standards, therefore this inquiry will focus only on the eighth-grade content standards for the study of technology and each of the student attainment benchmarks. This will allow for the exploratory design, construction, and testing of a psychometric instrument designed to measure the level of student learning in a technology education classroom guided by the national content standards.

Grounding of the Research Perspective

One of the important areas that must be expanded on across the discipline of technology education is the creation of useful instruction and instructional materials that will benefit students' attainment of technological literacy. By using research grounded in theories of cognitive science, educators will be able to relate their knowledge to demonstrated effective teaching and learning methods. However, as De Miranda (2004) asserts, technology education originated without any meaningful input from cognition science research (p. 1). Nonetheless, De Miranda suggests that technology education instructional methods are remarkably consonant with findings from cognitive science on the practices that define good instruction. De Miranda and Folkestad (2000) state the intent of instruction grounded in the cognitive sciences is to transfer "the self-regulation and monitoring of cognitive functions such as memory, process, control of thinking process, reflection, appropriate application, and the cognitive tools for thinking and learning from the teacher to the student" (p. 7).

The purposes of cognitive approaches are to integrate career, skills, and academic curriculum with technology to give students the opportunity to gain technological literacy and to compliment interact with other academic content. Once they learn about technology, the students will hopefully understand how English, math, and science, when properly integrated, relate to real life. Another way of thinking of technological literacy is the successful application of real people, real time, and real problems to real life (Feller & Whichard, 2005).

Recently, the study of technology has become necessary and more evident. Herschbach (1997) states that "rapid industrialization and technological change has placed new demands on schools to develop scientists, engineers, technicians, and skilled workers who will continue to propel the economy forward" (p. 24). As a result, many schools have adopted new science and technology programs that allow students to understand the connection between technology and academics (Hoachlander, 2006). At the same time, students learn how technology relates to other general courses (p. 39). A question arises, what are the benefits to student learning (thinking or ways of knowing) when technology education is integrated? Do the standards for technological literacy and cognitive approaches to instruction improve student's cognition or thinking and knowing about a subject?

The cognitive science literature demonstrates the value of integrating curriculum subjects, but has not yet identified how the integration of science, math, and technology education has improved students' achievement and/or their career success. De Miranda and Folkestad (2000) assert that one of the challenges of connecting cognitive science theory to technology education is that it requires teacher education programs to teach new methods of instruction and adopt new approaches to student learning. Some elements that we need to add or incorporate into the technology education curriculum is an assessment tool that will indicate the degree to which instructors are currently applying cognitive science theory in the classroom, and instruction on how to overcome barriers that prevent the use of these teaching models. Therefore, the testing of the psychometric instrument developed in this study was conducted in technology education classrooms that exhibit the instructional, environmental, and curricular recommendations from research and teaching in the cognitive sciences. This research frame suggests that when students are challenged and free to inquire, design, debug, question and solve problems related to technology, they will show learning gains in the attainment of their grade level standards benchmarks.

The literature review will begin to shed light on this issue by examining the history of technology education and the introduction of the Standards for Technological Literacy (STL) (ITEA, 2000). Currently, most of the information about the integration of technology education with math and science is found in publications from the 1980s to the present, in sources such as books, journal, and internet sites. The problem with this is that each source concentrates only on a specific topic or area; we need to provide resources that will give the teacher, faculty, parents, and students a more comprehensive understanding of the impact that technology education courses have on students' learning of science and technology concepts that equates to a level of literacy in each. Hence, the need for an instrument to measure technological literacy as defined by the STL. The literature review provides support and a rationale for the technological literacy measurement tool designed and tested in this study.

Definition of Terms

Career and Technical Education – Kindergarten through adult programs of study that include rigorous academic content closely aligned with career and technical subject matter, using the state-developed learning standards for career development and occupational studies as a framework. In grades nine through twelve, career and technical education includes the specific disciplines of agriculture education, business and marketing education, family and consumer science education, health occupations education, technical education, technology education, and trade/industrial education (formally known as Vocational Education) (100.1 Definitions, retrieved February 8, 2006, from http://www.emsc.nysed.gov/part100/pages/1001.html#career%20and%20technical%20education).

Educational Technology – Using multimedia technologies or audiovisual aids as a tool to enhance the teaching and learning process (International Technology Education Association, 2000).

Industrial Arts – Those occupations in which changes are made to materials to increase their values for human usage. As a subject for educational purposes, industrial arts is a study of the changes made by humans to materials to increase their values, and of the problems of life related to those changes (Olson, 1963).

Industrial Education – A field of study designed to prepare technical and/or management-oriented professionals for employment in business, industry, education, and government. Industrial Technology is primarily involved with the management, operation, and maintenance of complex technological systems while engineering and engineering technology are primarily involved with the design and installation of these systems (National Association of Industrial Technology, retrieved February 8, 2006, from http://www.nait.org/).

Industrial and Technology Education – A kindergarten-through-university career pathway of well-planned experiences. These experiences prepare students for successful transition to the workforce (Industrial and Technology Education: Career Path Guide and Model Curriculum Standards, 1996. p. iv)

Science Literacy – Knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity. It also includes specific types of abilities. In the *National Science Education Standards*, the content standards define scientific literacy. (National Research Council, 1996).

School-to-Career – Provides students with the necessary academic and vocational-technical education to transition from secondary education to high-quality employment and further education (California Department of Education, 2006, April 4).

Technology – Application of knowledge and the use of resources to meet human needs and solve problems. (International Technology Education Association, retrieved February 8, 2006, from http://www.iteaconnect.org/index.html).

Technology Education – Technology education is a school subject that teaches students in grades K- 12 how to be technologically literate. In technology education, learning is brought to life through concrete, hands-on learning experiences in laboratory environments. Through drawing, planning, designing, problem solving, building, and testing, students become involved in critical and creative thinking and creative activities. Students explore, ask questions, use resources of information, and learn to construct solutions that lead to more questions and additional solutions. They also learn that there is no perfect design that meets all the criteria and constraints, and therefore, the best design must balance tradeoffs (California Department of Education, 2005, May 20).

Technology Literacy – "computer skills and the ability to use computers and other technology to improve learning, productivity, and performance." A goal related to technology literacy is to ensure that all students and teachers have equitable access to and can make effective use of technology (North Central Regional Educational Laboratory, retrieved February 8, 2006, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te4lk7.htm).

Technological Literacy – Technological literacy involves the ability to use, manage, and understand the myriad of technology surrounding us. The technologically literate person has knowledge and understanding of our technological surroundings (International Technology Education Association, 2000).

Tech Prep - Designed to implement programmatic connections between high schools and two-year colleges encompassing specific technical fields and occupational areas (California Department of Education, 2006, March 23).

Research Questions

The purpose of this study is to design and test an assessment instrument to measure eighth-grade achievement in the study of technology. The following research questions are addressed:

1. Can a reliable and valid psychometric instrument be designed to measure eighth-grade technological literacy as defined by the Standards for Technological Literacy: Content for the Study of Technology (ITEA, 2000)?
2. Does technology education instruction improve technological literacy in students, as measured by a technology literacy test constructed for this study?

Assumptions

The design and testing of an assessment instrument to measure eighth-grade achievement in the study of technology was guided by fundamental principles of classical test theory and measurement. For this type of quasi-experimental representative design, the following assumptions were made about the study, its context, and the classroom:

1. The technology education programs involved in this study are representative of middle school technology education programs in the United States. Those students participating would be in the eighth grade taking traditional courses with and without technology education classes. Two hundred seventy two eighth-grade students participated in this research.
2. Demographics of the school, student ethnicity, participation in Title I program and technology education instruction were homogeneous.
3. Students participating in this study have a wide range of cognitive abilities and participate in the regular eighth-grade curricula.

Limitations

This study was conducted in light of the following limitations:

1. The schools used for this study offered technology education classes where cognitively based modular approaches to instruction were used.
2. The data for this study was from a convenience sample of students from schools located in a major urban area located in Southern California.
3. Due to the random selection of test items from a larger test item bank, the potential exists that not all eighth-grade benchmarks were tested.
4. Not all test forms were used in the final testing of the technology literacy assessment.

Other limitations could consist of the quality of the program, teacher effects, and how the students perform in traditional academic courses, in addition there is no control over participant background.

Significance of the Study

As described previously, existing data does not positively link technology education instruction to the advancement of technological literacy in students. The focus of this study is to acquire information to understand if the Standards for Technological Literacy: Content for the Study of Technology (ITEA, 2000), when followed appropriately, facilitate technological literacy for all students. To date, no clear methods for measuring and assessing these standards have been proposed or instituted.

This nation's increasing rate of technological change has placed new demands on schools to develop skilled workforce members to meet anticipated demands. No assessment instrument has been developed to specifically identify how the integration of technology education has improved students' achievement and/or their career success. More focused research is required to determine the benefits of integrating technology education into the curriculum in order to assess whether the current standards for technological literacy and academics improve student's cognitive abilities. Therefore, there is a critical need for an instrument to measure technological literacy as defined by the STL.

Hypotheses

The focus of this study is to measure the impact of instruction in technology education and to determine if technology education instruction is enhancing students' technological literacy.

Therefore, the hypotheses explored in this study are:

Ho: There is no significant impact on students who took a technology education class compared with those who did not take a technology education class.

H_1: There is a significant impact on students who took a technology education class compared with those who did not take a technology education class.

Ho: There is no significant difference between males and females who studied technology education as measured by the technology literacy test designed and tested in this study.

H_1: There is a significant difference between males and females who studied technology education as measured by the technology literacy test designed and tested in this study.

This study will attempt to examine the interaction and the impact of student achievement in technology and traditional courses by studying both academic and technology subjects concurrently in a school curriculum in diverse schools.

Researcher's Perspective

The researcher brings a seven-year background in the industrial arts and technology education instruction to this research. The experience that I have gained in the classroom as a technology teacher has provided me with knowledge by way of trial and error to refine the instructional methods I use in the classroom. This is because in technology education, we have lacked research-supported theories on learning and instruction, and have relied on our lab-based design and problem-solving instructional approaches to enhance learning. This research, if its hypotheses are validated, will in turn validate the methods I have developed as a teacher by trial and error and those that have been handed down to me through the conventional wisdom of the discipline.

In my experience, technology education instruction has focused on hands-on activities rather than abstract learning. However, I am increasingly aware that today's technological world demands more verbal explanations, more critical thinking, more consideration of options and alternatives, and deeper evaluation of the purpose or outcome of assigned tasks. Having a validated instrument that would allow a school or school district identify how technologically literate a student is after middle school or high school would help validate the importance of the Standards for Technological Literacy (STL). At the same time, the results can allow us to demonstrate the impact of being technologically literate on student's achievement. If tenable, this would assist us to better understand how students learn and at the same time how teachers can develop technology education programs that foster, the fluency needed in this age of mandated technological literacy.

CHAPTER 2: LITERATURE REVIEW

Evolution of Technology Education

The early development and origins of technology education can be traced as far back as the Stone Age. The discovery of drawings and artifacts in caves has provided and an idea of how cave dwellers began to develop their skills and how they passed them on to their young ones so they could follow their traditions. Progress was slow since early people lived in relative isolation. According to Bensen (1995), "one civilization often had to discover another in order to increase the chances of transferring technology back and forth between them" (p. 6). In an article describing the progression of technology education (1985), Kenneth Phillips mentions that in early times "skills of the hands" were passed from generation to generation by imitation from parent to child or from one individual to another by working together in a close relationship (p. 15). In order to make technology education more systematic, it became necessary to create a form of formal education that could be learned and passed down to new generations.

According to Strong and Schaefer (1975), the U. S. Government has always provided encouragement for education of all types. In fact, one of the first areas of education to receive federal funds was designed to stimulate and support the growth and development of occupational competencies. For instance, the creation of one of the first acts related to industrial and vocational education dates as far back as the Morrill Act of 1862, which provided the endowment of agriculture and mechanical classes in each state at the higher education level. As a result, this act provided 30,000 acres of public land for the training of students in agriculture. In addition, with the threat of World War I in 1914, the development of a new act for vocational education emerged. In 1917, the

Smith-Hughes Act provided the first categorical financial support for vocational education. This act was important not only for the funds that it provided, but also for establishing a pattern of federal-state cooperation in vocational education. However, the Smith-Hughes Act of 1917 was designed to provide funds only for agriculture and it was not until the following year, in 1918, that funds were available for implementing industrial vocational programs. Subsequently, debates ensued about what vocational education entailed and a clear distinction between general and vocational education began to emerge. At this time, vocational education was specifically for lower income students (Barlow, 1967). Consequently, the separation of general education and vocational education created new kindergarten-to-high school programs for students and adults seeking advanced training, and the way they were introduced to this training was through the integration of vocational programs into the general educational system.

Pre-World War II

Russian Manual Training

Since the 1870s, individuals such as Johann Heinrich Pestalozzi, Philip Von Fellenberg, and Victor Della Vos have influenced the paradigm of vocational education (Barlow, 1967). By the 19th century, the Russian system implemented a new way of teaching manual training. McClure, Chrisman, and Mock (1985) stated that when Victor Della Vos became the director of the Moscow Imperial Technical School in 1868, he improved teaching manual training. Della Vos decided to separate the theory and the practice of teaching manual training. This changed the way of instruction in the laboratory. Della Vos's new approach was designed so that each class had a shop for each activity taught (Bennett, 1937). For example, after a metal class, students had a shop that taught them to care for their tools and machines, as well as basic production, operation, and utilization techniques. In each shop, a student had both a work place and tools. All student projects began with working drawings and increasingly progressed in difficulty. Students could not continue to a new model or project until they had satisfactorily completed the previous model by demonstrating basic knowledge and skills in the subject. This model of instruction was reminiscent of mastery learning techniques (Block, 1971; Gentile, 2004).

At the training schools, emphasis was placed on the experience and skills of the instructor. Instructors concentrated on lectures, exercises, and demonstrations. McClure, Chrisman & Mock (1985) stated that, "The shop was so structured with its lectures, teacher-selected exercises, demonstrations, instruction sheets, and illustrations that there was no little or no room left for student creativity" (p. 21). The instructors practiced constantly to keep their skills in optimum condition to provide a model of perfection for their students. This system specified what a person should know for a job, the necessary steps or procedures, the related knowledge necessary for manipulative instruction, and instructional methods. One distinct quality of the Russian system was its lack of focus on construction of useful articles. As a result, students paid more attention to skill-improving exercises, rather than to actually constructing and finishing a project.

The Centennial Exposition Exhibition in 1876 was a great stage for the introduction of the Russian system. In the book, *Education for Work*, McClure, Chrisman and Perry (1985) mention that after examining the Russian exhibit, John D. Runkle of the Massachusetts Institute of Technology recommended that the trustees create training shops for engineering classes, manual training, and industrial courses.

Throughout most of the 1800s, manual training was integrated into the general education curriculum. Some courses offered during that time were mechanical drawing, woodworking, and metalworking. Nonetheless, as McCarthy stated (1950), "it did not take long to discover that the manual training programs were not serving the needs of a growing American industrial civilization" (p. 15).

Manual Training in the United States

The manual training movement began in America in the mid 1800s. In 1855, Professor Calvin M. Woodward opened one of the first manual training schools in America. At his school, evening classes where taught for apprentices along with classes in math and mechanical drawing. Later, the school progressed to full day instruction. According to Barlow (1967), Woodward had decided that manual training should be combined with a classical liberal education (p. 35). As Dean of the Polytechnic faculty of Washington University, Woodward believed engineers should construct wooden models to accompany their designs and demonstrate mechanical principles. Woodward quickly determined that the engineers lacked skills with hand tools that were necessary to construct their models. Woodward established a shop and hired a carpenter named Noah Dean to instruct the engineering students in the use of hand tools. This began the manual training idea in the United States. Woodward later became the president of Washington University. From his experience, Woodward had come to appreciate and therefore supported the role of manual training in general education (Bennett, 1937).

According to Bennett (1937) and Barlow (1967), Calvin Woodward started the manual training program at Washington University in 1869. According to Lewis and Zuga (2006), Woodward's curriculum was similar to the curriculum in Russia being taught by Victor Della Vos. The idea was to give students good skills for a trade after leaving school. The manual training movement was influenced by the impact of the Russian system, their manual training programs, and the Scandinavian *sloyd* manual arts method, which involved the creating a simple, useful article and then progressing to a more complex one.

Swedish Sloyd

Sloyd, which means dexterity or manual and artistic skill, developed in Sweden and other Scandinavian countries throughout the 19^{th} century. It began in the home; people would make tools, furniture, household articles, and clothes. In other words, the *sloyd* system skills were passed down through families. This process was so highly structured and formal that only the older or most dedicated students managed to continue with this system, (McClure, Chrisman & Mock, 1985, p. 21).

Uno Cygnaeus, the founder of the Finnish Folk School System, believed that *sloyd* should be incorporated as part of the formal education system for all students. Through the influence of Cygnaeus, Swedish educator Otto Solomon came to understand the general pedagogical significance of *sloyd.* In 1868, Otto Solomon founded a *sloyd* training school in Naas, Sweden. At his school, teachers from around the world came to learn his system of incorporating *sloyd* as part of a general education rather than a trade education (Bennett, 1937).

According to McClure, Chrisman and Mock (1985), "The *sloyd* system emphasized the physical and mental development of the child as well as the acquisition of skills. It also approached the task in terms of the students completing an entire project that combined beauty and usefulness, and relied on highly trained teachers rather than artisans as the instructors" (p. 22). As a result, many of the students learned to demonstrate their skills and knowledge. Characteristics of *sloyd* include progression from easy to difficult work, instruction by general educators rather than specialists or tradesmen, the construction of valuable and useful items, and a system of beginning each project with a mechanical drawing. Influences from this system can still be felt in America today and are very evident in Scandinavia (Bennett, 1937).

Manual Arts

According to Bennett (1937), the term manual arts originated about 1894 and grew out of the manual training movement (p. 70). Because of its place in the general education curriculum and its focus on practical projects, this trend found its influence primarily in the Swedish *sloyd* system rather than the Russian system of manual training. In the manual arts movement, students were involved in the design and manufacture of craft-oriented projects. These projects used to teach tool skills and knowledge (Bennett, 1937, p. 64). Both industrial arts and technology education evolved from this movement.

Arts and Crafts Movement

McClure, Chrisman and Mock (1985) explain that the introduction of the arts and crafts movement occurred about the same time as the Russian and *sloyd* systems. The arts and crafts movement tended to put more emphasis on creativity and beauty instead of the acquisition of skills. The goal was to encourage students to be more creative in areas such as modeling, carving, and drawing, since factory production had taken beauty and artisanship away from most items that were mass-produced. This movement spread to America and strongly influenced individuals such as Frank Lloyd Wright and John Dewey. According to Lewis and Zuga (2006), the intention of Dewey was to create a different way of instruction in industrial arts (p. 9). Lewis and Zuga affirm that due to the philosophy of Dewey and the practices of *sloyd*, industrial arts was formed (p. 8).

Industrial Arts

Charles R. Richards, director of the Manual Training Department at the University of Missouri, first used the term "Industrial Arts" in 1904 (Olson, 1963). This term was used to describe education that was part of the general education program in the secondary levels of education (p. 9). Due to inadequate facilities, the goal of industrial arts was not implemented uniformly throughout the nation (McCarthy, 1950, p. 116). According to Olson (1963), industrial arts was called the third stage in the evolution of shop work instruction (p. 5). Charles A. Bennett asserted that the term industrial arts emphasized “industrial” while manual arts emphasized “arts.” Herschbach (1997) states that industrial arts provided real experiences that enabled students to understand and apply their skills to real scenarios, and not just to mastering a technique.

Post-World War II

1940s

With the end of WWII, the United States government decided to educate and provide training in the areas of mathematics, science, and vocational education (Barlow, 1967). The high demand for these classes was due to their shortage, since the previous types of education were primarily focused on agriculture and mechanical training. Hence, there was a boom in the nation’s awareness of vocational education, leading to the creation of the National Defense Act (1940 to 1946). The goal of the act was to create vocational training for national defense needs. At the same time, the first curriculum proposal, entitled “A Curriculum to Reflect Technology,” was developed under the direction of William E. Warner and a group of graduate students at The Ohio State University (Kennett, 1985).

1950s

The concentration of vocational and technology education programs increased through the 1950s, which also created a demand for more trained individuals in vocational training programs. For instance, individuals returning from World War II after serving their country wanted vocational guidance and placement in areas in which they had received training while on duty (Strong & Schaefer, 1975). Furthermore, the launching of Sputnik by the Union of Soviet Socialist Republic (USSR) in 1957 led the United States government to realize that they needed to provide the American people with a more mathematical and scientific educational training, along with the necessary vocational and technical training to compete with the USSR.

1960s and 1970s Human Productive Practice

Carl Perkins and Wayne Morris saw a need to enhance vocational education and established the Vocational Education Act of 1963. The act was created to modernize vocational education by providing more flexible programs with fewer restrictions in the allocation of funds. However, the Act did not fund or provide support funds to types of employment that required less than a bachelor's degree.

Industrial Arts went through a transition period where the emphasis moved from industrial arts to technology education. According to Starkweather (1986), justification for curricula for technology education was to enable individuals to practice, process, and apply their technological knowledge in their environment, and enable them to make coherent decisions regarding the impact of technology on their daily lives (p. 5).

1980s through the Present

The definition of the term "industrial arts" marked the beginning of the characterization of industrial arts study as a comprehensive field of study and evolved from the Jackson's Mill Industrial Arts Curriculum. It provided a foundation for modernization of curricula using four major content areas concerned with (1) technology evolution, utilization, and significance, (2) personnel, systems, techniques, and resources of industry, (3) technology products, and (4) technology's social/cultural impact (Snyder and Hales, 1981). Lewis and Zuga (2006) mention that William Warner and a team of graduate students' recommended six content organizers: management, communication, construction, power, transportation, and manufacturing (p. 9). Today, these content areas are organized around manufacturing, construction, environment, communication, and transportation.

In 1984, 1990, and again in 1998, the federal government became a strong supporter of three technology education programs. The first, Tech Prep, was a name given to programs that offered at least four years of sequential coursework at the secondary and postsecondary levels to prepare students for technical careers. The second, School-to-Work programs were designed to transition students successfully into the economy, through paid employment in either business or self-employment. The thirds was School-to-Career programs, a system of educational opportunities that promoted high academic standards, prepared students for the challenges for the 21st century, and provided vocational programs (California Department of Education, 2006). For example, in 1990 the State of California supported the State Plan for Carl Perkins's Vocational Technology Act of 1990, which stated in Section 235 that a program receiving federal funds should integrate academic and vocational education in such programs through coherent sequences of courses so that students achieve both academic and occupational competencies (U.S. Department of Education, 2002).

In summary, vocational and technology education continued to exist under the most recent federal legislation. The problem, according to Lewis and Zuga (2006) is selecting the appropriate curricula associated with technology and determining how to effectively implement it. They assert that due to the rapidly transformative nature and intent of the subject matter, technology education will continue to be a challenge (p. 5).

Technology Education Movement

The technology education movement of today arose because of the industrial arts movement. Today, like industrial arts, it is generally part of the general education curriculum in most states. Technology education has influenced the development of general education since the early 1800s. According to Gordon (2003), the introduction of technological courses allowed students to develop basic skills, thinking skills, and personal qualities (p. 166). However, since its inception, technology education has constantly been overlooked in comparison to other general educational programs.

As a result, while many schools have adopted new science and technology programs that will allow students to understand the connection between technology and science and how it relates to other general courses, a question arises as to whether integrating technology education improves students' cognition or thinking and knowing of these subjects.

Technology education curriculum has evolved from a rich tradition of hands-on, team-oriented, project-based learning commonly associated with activities in industrial arts. The teaching methods have been touted as the strength of technology programs for years. Although cognitive science research has provided evidence to potentially sustain the validity of this claim, technology education instructors continue to focus on anecdotal evidence. The emerging discipline of technology education needs to focus on current cognitive research by seizing the opportunity to illustrate the significance and importance of its programs and instructional methods (Sirotnik & Soder, 1999). The foundations of cognitively based models hold that the three elements of learning should emphasize engagement, student reflection, and communal interaction. These foundational learning elements are evident in technology education through student design activities, production of artifacts, problem solving, and project-based activities (Spector & Anderson, 2000).

In a recently published best practices book, Martin and Martin (2006) provide several instructional strategies for the middle-school level. Those examples exemplify cognitively based models of instruction. For example, Robert Steketee, a middle school teacher, develops lessons and projects that have each student or a pair of students design and build projects that are part of a larger group project (p. 55). This approach is consonant with the research recommendations from the cognitive sciences on distributed expertise and design experiments in the classroom (p. 55). Another example where students learn about design and how it is used in industry is the curriculum practice of technology educator Teri Tsosie. At the end of each week, students have the opportunity to put a design process in practice by solving a problem of the week (p. 86). The approach in this activity is problem-based instruction. These examples of technology education class at the middle school exemplify best practices and a cognitively based model from research that emphasizes engagement, student reflection, and community interaction.

Standards for Technological Literacy: Content for the Study of Technology

The Standards for Technological Literacy (STL) were developed by the International Technology Education Association's Technology for All Americans Project (ITEA-TfAAP) (Standards for Technological Literacy, 2000, p. vii). The release of the STL marked a momentous achievement for the field and served as a catalyst for instructional, curricular, and programmatic change. To date the full impact of the release of the STL on the field of technology education is unknown and little empirical evidence exists to guide teachers and program administrators.

Review of STL

The technology content standards are organized into five major categories. Each category represents the content of what each student should be learning at four levels, grades K-2, 3-5, 6-8, and 9-12 and standard benchmarks are identified by an alphabetical listing (e.g., A, B, C) (Standards for Technological Literacy, 2000). According to the STL, each standard and benchmark has a connection from previous standards and benchmarks for the purpose of building and prescribing what a student should know and the able to do to be technologically literate (p. 12). The categories are organized into 20 standards; each individual standard has two components: what students should know and understand about technology and what they should be able to do. The benchmarks provide the fundamental content elements for the broadly stated standards. However, the discussion in this literature review will be limited to the category, standards, and benchmarks of the level of interest of this study—grade level 6-8.

Category One: Nature of Technology

This category is organized into three standards:

Standard One

Standard one has four benchmarks in which students will develop an understanding of the characteristics and scope of technology. To comprehend the scope of technology, students in grade 6-8 should learn that: (F) New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (G) The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative. (H) Technology is closely linked to creativity, which has resulted in innovation. (I) Corporations can often create demand for a product by bringing it onto the market and advertising it.

Standard Two

Standard two is organized into ten benchmarks to recognize the core concepts of technology. To recognize the core concepts, students in grade 6-8 should learn that: (M) Technological systems include input, processes, output, and at times, feedback. (N) Systems thinking involves considering how every part relates to others. (O) An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback. (P) Technological systems can be connected to one another. (Q) Malfunctions of any part of a system may affect the function and quality of the system. (R) Requirements are the parameters placed on the development of a product or system. (S) Trade-off is a decision process recognizing the need for careful compromises among competing factors. (T) Different technologies involve different sets of processes. (U) Maintenance is the process of inspecting and servicing a product or system on a regular basis in order for it to continue functioning properly, to extend its life, or to upgrade its quality. (V) Controls are mechanisms or particular steps that people perform using information about the system that causes systems to change

Standard Three

Standard three is organized into three benchmarks in which students will develop an understanding of the relationship among technologies and the connections between technology and other fields of study. To appreciate the relationships among technologies and other fields of study, students in grades 6-8 should learn that: (D) Technological systems often interact with one another. (E) A product, system, or environment developed for one setting may be applied to another setting. (F) Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

Category Two: Technology and Society

This category is organized into four standards:

Standard Four

Standard four is organized into four benchmarks in which students will develop an understanding of the cultural, social, economic, and political effects of technology. To recognize the changes in society caused by the use of technology, students in grades 6-8 should learn that: (D) The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use. (E) Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences. (F) The development and use of technology poses ethical issues. (G) Economic, political, and cultural issues are influenced by the development and use of technology.

Standard Five

Standard five is organized into three benchmarks in which students will develop an understanding of effects of technology on the environment. To discern the effects of technology on the environment, students in grades 6-8 should learn that: (D) The management of waste produced by technological systems is an important societal issue. (E) Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems. (F) Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.

Standard Six

Standard six has four benchmarks in which students will develop an understanding of the role of society in the development and use of technology. To realize the impact of society on technology, students in grades 6-8 should learn that: (D) Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies. (E) The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (F) Social and cultural priorities and values are reflected in technological devices. (G) Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

Standard Seven

Standard seven is organized into four benchmarks in which students will develop and understanding of the influence of technology on history. To be informed of the influence of technology on history, students in grades 6-8 should learn that: (C) Many inventions and innovations have evolved using slow and methodical processes of tests and refinements. (D) The specialization of function has been at the heart of many technological improvements. (E) The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships. (F) In the past, an invention or innovation was not usually developed with the knowledge of science.

Category Three: Design

This category is organized into three standards:

Standard Eight

Standard eight is organized into three benchmarks in which students will develop an understanding of the attributes of design. To comprehend the attributes of design, students in grades 6-8 should learn: (E) Design is a creative planning process that leads to useful products and systems. (F) There is no perfect design. (G) Requirements for design are made up of criteria and constraints.

Standard Nine

Standard nine is organized into three benchmarks in which the students will develop an understanding of engineering design. To comprehend engineering design, students in grades 6-8 should learn that: (F) Design involves a series of steps, which can be performed in varying sequences and repeated as needed. (G) Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (H) Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

Standard Ten

Standard ten is organized into three benchmarks in which students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. To be able to comprehend problem-solving approaches, students in grades 6-8 should learn that: (F) Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (G) Invention is a process of turning ideas and imagination into devices and systems, while innovation is the process of modifying an existing product or system to improve it. (H) Some technological problems are best solved through experimentation

Category Four: Abilities for Technological World

This category is organized into three standards:

Standard Eleven

Standard eleven is organized into five benchmarks in which students will develop abilities to apply the design processes. As part of learning how to apply design processes, students in grades 6-8 should be able to: (H) Apply a design process to solve problems in and beyond the laboratory-classroom. (I) Specify criteria and constraints for the design. (J) Make two-dimensional and three-dimensional representations of the designed solution. (K) Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (L) Make a product or system and document it.

Standard Twelve

Standard twelve is organized into four benchmarks in which students will learn to use and maintain technological products and systems. As part of learning how to use and maintain technological products and systems, students in grades 6-8 should be able to: (H) Use information provided in manuals, protocols, or by experienced people to see and understand how things work. (I) Use tools, materials, and machines safely to diagnose, adjust, and repair systems. (J) Use computers and calculators in various applications. (K) Operate and maintain systems in order to achieve a given purpose.

Standard Thirteen

Standard thirteen is organized into four benchmarks in which students will develop the abilities to assess the impact of products and systems. As part of learning how to assess the impact of products and systems, students in grades 6-8 should be able to: (F) Design and use instruments to gather data. (G) Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology. (H) Identify trends and monitor potential consequences of technological development. (I) interpret and evaluate the accuracy of the information obtained and determine if it is useful.

Category Five: The Design World

This category is organized into seven standards:

Standard Fourteen

Standard fourteen is organized into four benchmarks in which students will develop an understanding of and be able to select and use medical technologies. In order to select, use, and understand medical technologies, student in grades 6-8 should learn that: (G) Advances and innovations in medical technologies are used to improve healthcare. (H) Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety. (I) The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccine is produced. (J) Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups.

Standard Fifteen

Standard fifteen is organized into five benchmarks in which students will develop an understanding of and be able to select and use agriculture and related biotechnologies. In order to select, use, and understand agricultural and related biotechnologies, students in grades 6-8 should learn that: (F) Technological advances in agriculture directly affect the time and number of people required to produce food for a large population. (G) A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals. (H) Biotechnology applies the principles of biology to create commercial products or processes. (I) Artificial ecosystems are human-made complexes that replicate some aspects of the natural environment. (J) The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food.

Standard Sixteen

Standard sixteen is organized into five benchmarks in which students will develop an understanding of and be able to select and use energy and power technologies. In order to select, use, and understand energy and power technologies, students in grades 6-8 should learn that: (E) Energy is the capacity to do work. (F) Energy can be used to do work using many processes. (P) Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done. (H) Power systems are used to drive and provide propulsion to other technological products and systems. (I) Much of the energy used in our environment is not used efficiently.

Standard Seventeen

Standard seventeen is organized into four benchmarks in which students will develop an understanding of and be able to select and use information and communication technologies. In order to select, use, and understand information and communication technologies, students in grades 6-8 should learn that: (H) Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human. (I) Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination. (J) The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message. (K) The use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas.

Standard Eighteen

Standard eighteen is organized into four benchmarks in which students will develop an understanding of and be able to select and use transportation technologies. In order to select, use, and understand transportation technologies, students in grades 6-8 should learn that: (F) Transporting people and goods involves a combination of individuals and vehicles. (G) Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively. (H) Governmental regulations often influence the design and operation of transportation systems. (I) Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently.

Standard Nineteen

Standard nineteen is organized into six benchmarks in which students will develop an understanding of and be able to select and use manufacturing technologies. In order to select, use, and understand manufacturing technologies, students in grades 6-8 should learn that: (F) Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them. (G) Manufactured goods may be classified as durable and non-durable. (H) The manufacturing process includes the designing, development, making, and servicing of products and systems. (I) Chemical technologies are used to modify or alter chemical substances. (J) Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining. (K) Marketing a product involves informing the public about it as well as assisting in its sales and distribution.

Standard Twenty

Standard twenty is organized into four benchmarks in which students will develop an understanding of and be able to select and use construction technologies. In order to select, use, and understand construction technologies, students in grades 6-8 should learn that: (F) The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function. (G) Structures rest on a foundation. (H) Some structures are temporary, while others are permanent. (I) Buildings generally contain a variety of subsystems.

The goal of the content standards in STL is to guide and articulate what needs to be taught in K–12 laboratory classrooms with the goal of developing higher levels of technological literacy for all students (Standards for Technological Literacy, 2000, p. viii). Technological literacy is the ability to use, manage, understand, and assess technology. The standards were built around a cognitive base as well as a doing/activity base, and they include assessment checkpoints at specific grade levels K-12 (ITEA, 2000).

One of the key points disseminated by STL is that it the standards do not define a curriculum. Rather, they identify content for the study of technology in order to create a vision of what students should know, should be able to do, and should understand throughout grades K–12. As with standards in other content areas, the standards in STL are written statements about what is valued, which can subsequently be used for making a judgment of quality. Meeting all of the standards in STL through the benchmark sets will ensure that students gain a higher level of technological literacy (Standards for Technological Literacy, 2000, p. vii).

Relationship Between Cognitive Science and Technology Education

Although technology education originated without any meaningful input from cognition science research, it appears that technology education instruction and methods are remarkably consonant with findings from cognitive sciences that define good instruction. Specifically, there is considerable accord between how instruction in technology education and cognitively based instructional models such as collaborative learning, socially distributed experiences, design/engineering, and project-based instruction can be connected (De Miranda, 2004).

Through classroom experience and refining instructional methods by trial and error, technology educators have demonstrated the success of hands-on, lab-based design and problem-solving instruction. However, they have lacked a powerful connection or grounding between well-researched theories on learning and instruction that could help validate their experiences and support their instructional methods. The emerging discipline of technology education needs to focus on current cognitive research by seizing the opportunity to illustrate the significance and importance of their programs and instructional methods.

The Changing Role of Technology Education in Schools

Most educators share a goal of achieving a sustainable future for students and members of society. A sustainable future is one that encourages innovative opportunities for people to learn and prosper, that incorporates responsibility to maintain and restore the educational system, and that is based on a just, civil society. Career development professionals, technology educators, and career and technical education (CTE) professionals share these goals. The goal is to guide students to be successful individuals academically as well as provide them with a technical background that will allow them to participate in meeting the needs of an increasingly technological world. In this demanding world of skills and technological changes, educators can benefit from a comprehensive understanding of the emerging and often unfamiliar issues of CTE, career development, and technology education.

Daggett (2005) asserts that educators, policy makers, and the public need to support the mission of career and technology education and believe in the importance of promoting its mission as a way of ensuring students' post-school success. Exploring ways to bring together educators, policy makers, and the public (including business, policy, community, and parents) around this mission can contribute to a sustainable future for youth.

Career development and technology education have become more effective in the development of their programs, yet the way students learn the material has been a concern, particularly in understanding the role of technology and careers in the students' everyday lives. In addition, since its inception, career and technology education has constantly been overlooked in comparison to general education programs. In fact, Feller and Whichard (2005) suggest that although research illustrates its value, unfortunately, national support for more comprehensive career development planning is presently hampered by shifts in political priorities and mounting government deficits.

Era of Reform

Most of the recent debate in schools has focused on educational reform. The late 1800s created a change in the educational system in the United States, when the introduction of a free educational system slowly matured into a national right for children. According to Barlow (1967), "general enthusiasm for public schools was slow to develop, but over the next fifty years the idea of the common school, public and free, became woven unmistakably into the fabric of the American culture" (p. 30). Over the years, the curriculum of public schools has changed to reflect changing national concerns. For instance, the launching of Sputnik by the Union of Soviet Socialist Republic (USSR) in 1957 led the government of the United States to realize that they needed to provide more mathematical and scientific training along with the necessary technical training to better compete with the USSR. Consequently, the United States government decided to place an emphasis on education in the areas of mathematics, science, and technology. Concomitant with this national interest were funding increases to promote these subject areas. Recently, career development and technology education programs have gained national attention.

The 36th annual Phi Delta Kappa/Gallup poll reported by Rose and Gallup (2005), points out the public's attitudes towards public school reform, including the No Child Left Behind Act (NCLB). Some of the issues addressed focus on the public's assessment of public schools (Department of Education), asking citizens about the various venues for pursuing change, and exploring the public's opinion of the democratic and republican political parties' relationship to public education. Similarly, Daggett (2005) has produced central findings he believes could have an impact on the success of reform initiatives like NCLB. These finding ranged from creating a better school culture to creating greater community involvement and developing effective educational leadership.

Educational reform efforts are asking educators to come up with new ways to run and improve their schools. The challenge educators are facing is to build support networks to facilitate this change. The support should come by working together, creating opportunities for administration and faculty to come together to achieve a mutual set of goals (Daggett 2005, p. 6). Educators have to organize differently using new techniques and a new collective mentality. These techniques will have to be proactive and concentrate on positive change rather than long-term stability. This will make a difference in the way schools implement their curriculum because they will have to adapt to new changes and determine how such changes are to be introduced. These practices will allow educators to be more knowledgeable and more aligned with educational reforms and the goals these reforms aim to accomplish.

During the past decade, a target goal of improving the quality of teaching-credential programs has been implemented in order to better prepare teachers. At the same time, a common mission for the entire educational system is to prepare youth for the workplace (No Child left Behind, U.S. Department of Education, 2002). From the perspective of many educators, "No Child Left Behind" does not achieve the goal of closing the gap in terms of educational opportunities, and instead focusing on preparing students simply to take tests. Many educators feel that we are headed towards heavy reliance on standardized measures such as GPA and SAT to determine or deny admissions for further study, precisely at a time when more students are aspiring, expecting, and needing more education (Feller and Whichard, 2005).

Today's technology education curriculum was developed to meet the needs of society. Public high schools are failing to prepare a substantial minority population of graduates with skills expected of them today. The purpose of integrating academic curriculum with technology is to give students the opportunity to learn the theories of English, math and science and how they can be integrated with the use of technology. In recent curriculum reform trends, the goals has been to target students' skills in areas such as critical thinking, problem solving, or communication and incorporate these skills into areas or issues in real-world settings (Jones, 2002).

Connecting Cognitive Science Perspective on Learning and Instruction to Technology Education

An area of expansion and discussion across the cognitive literature is related to the subject of technology education and the creation of useful instruction and instructional materials that will benefit the student's acquisition of knowledge. The purpose of instruction grounded in the cognitive is to transfer "the self-regulation and monitoring of cognitive functions such as memory, process, control of thinking process, reflection, appropriate application, and the cognitive tools for thinking and learning from the teacher to the student" (De Miranda & Folkestad, 2000, 7).

De Miranda (2004) found that through experience in classroom teaching and refining instructional methods by trial and error, technology educators have witnessed the success of hands-on, lab-based design and problem-solving instruction but lack a strong component between well-researched theories on learning and instruction (p. 64). He continues by saying that research grounded in theory of the cognitive sciences may perhaps provide technology educators with a strong understanding and foundation in support of their experiences. The findings from cognitive research imply that all students, including technology students, must be active, collaborative participants in framing technology-related questions, designing and participating in data collection and analysis procedures, and must be able to predict and inquire about observed outcomes (Brown, 1992).

Foundations of cognitively based models hold three elements of learning that emphasize engagement, student reflection, and communal interaction and are evidenced in technology education through student design activities, production of artifacts, problem solving, and project-based activities (Spector & Anderson, 2000, 1999). De Miranda has also stated, "To make this connection and understand its importance relative to teaching, each model of instruction is reviewed and practical examples are given of how each model is applied in an educational context" (p. 9). In other disciplines, students often are limited in their ability to demonstrate understanding of the curricula because many times, the curriculum has emphasized memorization rather than understanding.

Role of the Teacher in Technology Literacy

The role of the teacher is evolving in technology education. One of the teacher's roles will be to develop and maintain the technological and pedogogical knowledge necessary to teach students (AETL, 2003). The teacher is responsible for what happens in the laboratory-classroom as well as motivating, encouraging, and advising students; signing and distributing appropriate forms; directing the discussion about inventors and inventions; and making arrangements for the actual lab activities (p. 99).

The task of the teacher has many dimensions: it involves the provision of a broad context of knowledge within which students can locate and understand the content of their more specific studies; it involves the creation of a learning environment in which students are encouraged to think carefully and critically and express their thoughts, and in which they wish to confront and resolve difficulties rather than gloss over them; it also involves constantly monitoring and reflecting on the processes of teaching and student understanding and seeking to improve them.

According to the AETL (2003), technology teachers and other content area teachers must help their students feel confident and engaged in developing technological literacy (p. 99). Most difficult of all perhaps, it involves helping students to achieve their own aims, and adopt the notion that underlies education: that students' learning requires from them commitment, work, responsibility for their own learning, and a willingness to take risks, and that this process has its rewards, not the least of which is that learning can be fun!

In other words, and to add another ingredient to our field, our teaching methods should be the outcome of our aims (that is, what we want the students to know, to understand, to be able to do, and to value), our informed conceptions of how students learn, and the institutional context with all of its constraints and possibilities. Many teachers in the field of technology, math, and science are encouraged to adapt and adopt new practices that acknowledge math and science. Teachers have to be committed to relating to youngsters of many cultures, including those young people who with traditional teaching might have dropped out or have been forced out of the educational system.

Role of the Student in Technology Literacy

According to AETL (2003) students who study technology will work on technogical problems, innovations, and inventions (p. 100). The role of students will be to learn, to interact with others in a community which is diverse, stimulating, and somewhat sheltered, and to grow (p. 101). Technology students will need to communicate their ideas and understanding to their teachers. They will need to take advantages of the resources available to help answer their questions, and look to potential careers in technology. In addition, students will need to be involved in extra-curricular activities such as the Technology Student Association (TSA), which provides educational experiences that enrich student development of technological literacy (p. 101). In summary, the AETL asserts that students committed to study technology should be able to discover the requirements for related careers and investigate what technology courses of study they might pursue to help them prepare for their futures (p. 101).

Student Cognition and Learning in Technology Education

Advancing Excellence in Technology Literacy (AETL, 2003) helps describe how students can be assessed and engaged in design, invention, innovation, experimentation in technology education. This technology classroom of learning activities, supported by documents such as the Standard for Technological Literacy (STL, 2000), the addendum series, Advancing Excellent in Technology Literacy (AETL, 2003), and the Measuring Progress (ITEA, 2004), help to guide technology education and best practices (Martin & Martin, 2006). These practices in turn lead to a suprising connection with recommendations from cognitive science. Indeed, recent recommendations in cognitive science literature identify at least four very powerful learning strategies that are supported in the technology education classroom. These strategies include collaborative learning, socially distributed expertise, design/engineering, and project-based instruction.

Cognitively-based Instruction Models in the Standards-based Classroom

Collaborative Learning

In cooperative and collaborative learning, students generally work together in groups of two or more (Gokhale, 1995). These are usually face-to-face groups but, with the rapid expansion and availability of communication and information technologies such as e-mail, this can also be done effectively at a distance. Gokhale asserts that collaborative learning involves students working together in some way to aid their learning (p. 1). There are a number of models of collaborative learning and these raise issues and concerns for both the teacher and student, as well as for course design and administration.

In a study conducted by Shumway (1999), the goal was to compare the effect of cooperative-cooperative and cooperative-competitive classroom goal structures on group problem-solving performance and students' attitudes toward their learning environment within the context of a problem-solving activity in a high school technology education laboratory. Shumway (1999) found that students participating in the cooperative-cooperative environment generally expressed more positive attitudes toward various aspects of their learning environment as compared with of students participating in the cooperative-competitive environment

An article by Concept to Classroom defines collaborative learning as a philosophy of interaction and personal lifestyle where cooperation facilitates interaction to accomplish an end product or goal (Concept to Classroom, 2004). Gokhale (1995) mentions that students involved in collaborative learning achieve higher levels of thought and retain information longer than individual students who work alone (p. 1). In all situations where people come together in groups, it suggests a way of dealing with people that respects and highlights individual group members' abilities and contributions. There is a sharing of authority and acceptance of responsibility among group members for the group's actions (De Miranda, 2004, p. 67). The underlying premise of collaborative learning is based upon consensus building through cooperation by group members, in contrast to competition in which individuals best other group members. Collaborative learning practitioners apply this philosophy in the classroom, at committee meetings, with community groups, within families, and generally as a way of living with and dealing with other people. De Miranda asserts that in collaborative learning emphasis is placed on the student's ability to discover, share, and use knowledge (p. 67).

Cooperative learning is defined by a set of processes which help people interact together to accomplish a specific goal or develop an end product which is usually content-specific. It is more directive than a collaborative system learning, which is closely controlled by the teacher (Concept to Classroom, 2004). De Miranda argues that collaborative learning and social distributed expertise reduces the cognitive load placed on the each individual student. He concluded that when students come together with separate understanding and meaning, they could help to construct knowledge in a far more effective manner than a single individual could cognitively construct while working alone (p. 68).

Socially Distributed Expertise

Another cognitively based model of instruction focuses on socially distributed expertise in the classroom. This model of instruction is designed to encourage a community of learners who harbor numerous qualities that benefit the group (De Miranda, 2004). According to Brown, Ash, Rutherford, Nakagawa, Gordon, and Campione (1993) ways of knowing are strongly connected to the social, cultural, and physical situations students experience in learning. Brown and Campione (1993) mention that the classroom philosophy linked with socially distributed expertise emphasizes individuals who design their own learning and share their expertise with their peers.

A study conducted by Hilton (2003) investigated if students engaged in integrated technology, mathematics, and science education curricula taught by a technology education teacher would have an increase in cognitive learning compared to high school students not receiving an integrated curriculum in technology, mathematics, and science education. Hilton (2003) stated that school-age children across the country did not use the computer at home for such higher-order cognitive activities and suggested that technology training for teachers increased their use of the computer for instruction, although students' final science course grade did not improve.

De Miranda (2004) maintains that students and teachers each are entitled to certain forms of expertise, but that no one has all of the expertise. De Miranda continues by stating that each responsible member of the group shares the expertise they have and is responsible for the finding needed knowledge. Because of group participation and collaborative discussion, the group collectively uncovers and unifies their expertise to develop a cohesive body of knowledge possessed by no one individual (p. 68). To achieve this condition it is important for groups to assure joint responsibility and a classroom ethos of collaboration.

Technology education classrooms can capitalize on socially distributed models of instruction where students come to recognize that even experts do not always know the answers (De Miranda & Folkestad, 2000). Respect among peers, teachers, and experts outside the classroom is earned through responsible participation in the knowledge-building process. Students, teachers, and outside experts listen to each other and come to respect the contributions each brings to the group (p. 9). De Miranda and Folkestad state that in a socially distributed learning group in technology education, students construct new understandings by developing a common body of knowledge and a common voice that can be shared with other groups in the class. In the process of participating in socially distributed learning activities, students contribute to authentic learning of technological content while fostering a sense of ownership as they assume roles within learning groups (p. 9).

Another example of a socially distributed model of instruction that is well suited for a technology education classroom is the Jigsaw Method modified from Aronson (1978). According to De Miranda (2004), in the jigsaw method of cooperative learning students are assigned part of a classroom topic to research and learn and then teach to others in a group in the class. De Miranda reaffirms that in effect, students are responsible for doing collaborative research and sharing their expertise with their peers within and between classroom groups (p. 69). De Miranda provided an example on how the jig saw method could be use in the technology classroom scenario: A class is divided into five learning groups with the task of researching, designing, and constructing a model of a light-rail transportation system for their city; each group would be responsible for gathering one-fifth of the information related to the task. Each student in a learning group is a resident expert on one part of the transportation system; they teach it to others and prepare questions for other groups on topics related to their area of responsibility. Collectively, all five learning groups take on the completed task of designing the transportation system.

According to Brown (1993), students in socially distributed models of learning are far from passive recipients of incoming information. Students take on the role of active researcher and teacher, monitoring their own progress and that of others when they adopt the role of a constructive critic. De Miranda concluded that the constructive critic role in technology education is the self-regulating role students assume when they assess, evaluate, question, and control the work in which they are engaged. Teachers in socially distributed classrooms change from managers and didactic teachers to models of active learning by coaching and guiding students (p. 69). In order words, the introduction of socially distributed expertise in classrooms can add a great value to the educational process, has been validated as a successful cognitively based model of instruction in technology education.

Design/engineering

According to diSessa (1992) and De Miranda (2004), viewing and cultivating students as designers/engineers in science and technology supports productive activities in classrooms. DiSessa argues that activities requiring designing and constructing engage students in the externalization of physical artifacts that present many opportunities for reflecting, debugging, and keeping the goals of the activity in focus (p. 70). This means that students connect and understand the importance of self evaluation due to the activity by concluding how well their designed object functions. De Miranda noted diSessa's findings that students engage in self-evaluation as a result of the activity structure by determining how well their designed object works. He reports that a design/engineering approach provides ample opportunities for students to collaborate and share. DiSessa explains that the type of sharing encountered in the design/engineering approach is consonant with the instructional benefits of socially distributed instructional models (p. 69).

One of the benefits of engaging students as designers/engineers is the students' personal investment in the learning activity (De Miranda, 2004). De Miranda (2004), diSessa (1992), and Brown (1993) confirm that the development of product or expert knowledge can generate sustaining effects through personal or group pride in ownership. The development of products in the design/engineering model of instruction provides multiple opportunities for students to cooperate and share. DiSessa found that big design projects allow many slots for individuals with different skills and expertise to participate effectively (p. 70). Similarly, De Miranda suggested that technology education design and technology (D&T) activities are consistent with the design/engineering approaches to instruction in the cognitive science tradition. In D&T activities, some students may take on primary responsibility for design, others for construction, and others for evaluation and testing (p. 70). Consequently, the design/engineering model is an additional method of instruction that can be applicable to technology education and that has an affinity with a cognitive approach to teaching and learning.

De Miranda asserts that technology education students can be engaged in design/engineering activities that require them to design and construct models that aid in the explanation of technological principles being studied (p. 70). For example, in the study of resistance, students would be challenged to design and construct a small sliding sled capable of holding a 5-kg weight. Students would be responsible for collecting data on the amount of force required to pull the sled at a constant speed across the surfaces of rough and smooth materials using a spring balance. Students would be required to explore, apply, and present solutions for reducing the resistance created by the varying surface conditions (p. 70). De Miranda concluded that the power of design/engineering approaches resides in motivating learners to build on ideas and intuitions they bring to the learning environment to construct functional, qualitative representations that work in demonstrating the physics principles affecting the technology under study (p. 70).

Project-based Instruction

According to Pea and Gomez (1993), science and technology instruction must incorporate new ways centered on understanding and doing-that-supports-learning, and conversely, most current educational models are based on learning-before-doing. Pea and Gomez assert that attention in science and technology education classrooms must be focused on learning-in-doing. Learning-in-doing is a model in which learners are increasingly involved in the authentic practice of applying technology through learning conversations and activities with other students that include and extend past educators and peers to expert practitioners in the field who support work-based learning outside the classroom.

According to De Miranda (2004), learning-in-doing requires interaction among groups that traditionally have been separated by the institutional boundaries of work and school (p. 71). Pea (1993) argues that progress in the field of communications, especially in the area of high-performance computing and Internet communications, can provide classrooms with possibilities for linking these communities in significant ways for learning. Pea states that relying on information networks and multimedia services makes what he calls distributed-multimedia learning environments (DMLE). Pea asserts that DMLEs can improve on project-enhanced technological learning in the areas of science and technology education, since experts in the field can be contacted or reached by students and consulted with if questions arise during the completion of a project.

According to De Miranda (2004), this project-based approach to learning establishes collaborative technology learning environments, or “collaboratories,” that enable project-enhanced science/technology learning (PES/TL) among remote project partners using advanced telecommunication networks (p. 71). He continues by asserting that PES/TL extends the collaborative reach of technology education classrooms to include widely dispersed expertise among learners, teachers, scientists, and learning researchers. He described an example of collaborative project with technologists at the National Center for Super Computing Applications (NASCA) where learners were provided with access to subject-matter experts, visualization tools, and vast databases in the field of atmospheric technology. The students worked collaboratively in project investigations on topics such as severe storms, weather fronts and air pressure systems, ozone depletion trends, and global warming (p. 71).

De Miranda (2004) asserts that student participants in PES/TL environments refine questions and select project topics, design procedures for data collection, and conduct sense-making activities. At the conclusion of this activity, students have data that can be used in different ways such as multimedia reports and presentation of project investigations that can be shared among their peers, technology education classrooms, or student research teams across the country (p. 71).

De Miranda (2004) argues that the authentic activity structure of technology education combined with a large portion of instructional time allocated to student collaboration fosters a classroom environment that favors project-based student inquiry assignments. Pea (1993) reported that in a "project–enhanced" learning environment students are able to frame questions and propose solutions based upon their own research and experimentation. One of Pea's primary assertions was that scientific and technological inquiry should extend beyond the classroom and engage students in project-based activities in which teams of student researchers and off-school-site experts interact to collaboratively examine common problems and seek solutions (p.92).

Cognitive Science and the Technology Education Classroom

According to De Miranda (2004), the similarity between research recommendations from cognitive sciences and models of learning and instruction derived from exemplary practice shows that cognitive-based models embrace three elements of learning and instruction common across various instructional strategies. Those similarities as described by De Miranda include:

1. The learner actively engages the learning process and content;
2. The instructional design requires the learner to reflect on and use existing structures of knowledge to guide and further his or her learning; and
3. Classrooms are communities of learning where knowledge and information are shared openly in an environment that values participation and interaction among students, teachers, and external sources of knowledge outside the classroom (p. 65).

In summary, the design characteristics and instructional practices found in many exemplary technology education classrooms concur closely with the cognitive science view of learning, knowledge, and instruction. Specifically, technology education can align itself with the view of the student as an active participant in the instructional process, free to reflect, monitor, evaluate, and engage in self-regulation. Extensive uses of socially distributed expertise in the classroom and the use of projects in the form of student design constructions support a collaborative classroom ethos. The ability of students to manipulate and create design solutions, participate in collaborative projects with their peers, and connect technology-based activities in the classroom to authentic practice outside of school represent powerful evidence that learning and instruction in technology education can meet the current reform demands recommended by research on learning and instruction in the cognitive sciences. Therefore, technology education instruction must continue to focus on the process of learning-in-doing rather than just doing. Society now demands that students think critically, consider options, evaluate their choices, and develop processes to achieve the purpose or outcome of the lesson.

How Students Learn

In 1999, the National Research Council published the report "*How People Learn*" which asserts that the need for understanding how humans learn has undergone a dramatic change in the past four decade (p. 5). In addition, the report suggested the design of curricula, instruction, assessments, and learning environments. In brief, how students learn depends on how the educator in the classroom supports the lesson. For example, Driscoll (2003) asserts that educators should follow four board principles: learning occurs in context, learning is active, learning is social, and learning is reflective. Pellegrino (2002) also suggested other ways educators can have a better understanding on how students learn by integrating curriculum and instruction. Pellegrino added the following three principles to Driscoll's:

i) Students come to the classroom with preconceptions about how the world works which include beliefs and prior knowledge acquired through various experiences;

ii) To develop competence in an area of inquiry, students must: (a) have a deep foundation of factual knowledge, (b) undertand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retirval and application;

iii) A metacognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them (p. 2-4).

According to Bridglall (2001), these findings require that teachers integrate teaching and instruction into the curriculum. By doing this, the students will enhance their ability to learn independently and enhance their ability to explore and undertand the material. Bridglall suggested that in order to achieved this, schools and parents need to develop a partnership that would allow students to experience what they are taught in school coupled with real-life experiences either at home, school, or work.

Assessing What Students Know

The traditional role of assessment is to measure students' achievements in terms of the curriculum requirements, mainly for the purposes of ranking and selection. Assessment has been known as one area of education that is resistant to change because it has always been difficult to move away from its traditional roles. The current global trend is towards an approach where assessment is becoming more and more an integral part of the teaching-learning process. This entails significant changes not only in the way in which the assessment process is carried out but also in the way the results are being used.

Need for Assessing Technological Literacy

According to AETL, several groups, organizations, agencies, and institutions have made the case for technological literacy (p. 21). AETL asserts that the U.S. Commission on National Security/21st Century reported in 2001:

> "The health of the U.S. economy . . . will depend not only on [science, math, and engineering] professionals but also on a populace that can effectively assimilate a wide range of new tools and technlogies" (p. 39).

AETL (2003) reports that no defined research exists on how widespread technological literacy is and that levels of technological literacy vary from person to person, and depend upon backgrounds, education, interests, attitudes, and abilities. AETL continues by mentioning that the field of technology education has not been accepted as a core subject and that a massive, coordinated effort is needed to achieve a technologically literate populace (p. 12).

Developing a Standards-based Achievement Test

According to Worthen, White, Fan, and Sudweeks (1999), the origin of an assessment tool or test can be traced as early as 2000 B. C. Worthen, White, Fan, and Sudweeks (1999) state that in the United States, the first indication of a measurement technique was introduced in the mid-1850s by Horace Mann (p. 15). In the early 1900s through the mid-1950s, the development of assessment increased as it became the new standard for measuring individual performance. The 1970s witnessed the rise of an accountability movement that required each school district to set up educational goals, test them, and report them to state agencies (Worthen, White, Fan, Sudweeks, 1999).

In 2002, the Congress passed the No Child Left Behind Act, which requires regular accountability testing as a prerequisite for receiving federal fund (Fremer and Wall, 2003). No Child Left Behind requires that United States schools close the achievement gap, offer more flexibilty, give parents more options, and teach students based on what works. States must describe how they will close the achievement gap and make sure all students, including those who are disadvantaged, achieve academic proficiency (Department of Education, 2003).

In 2000, the International Technology Education Association (ITEA) released Standards for Technological Literacy: Content for the Study of Technology (ITEA, 2000). The purpose of these standards is for the student to achieve technological literacy by engaging in curriculum informed by the content standards and related benchmarks (ITEA, 2000). Between 2000-2003, a companion document for the STL was introduced entitlee, Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards (AETL). It was created to define how assessment of technological literacy should be designed and implemented (p. 3).

The AETL (2003) asserts that assessment goals define who and when to assess and what type of assessment tool or method to use (p. 18). The assessment standards in AETL are to be utilized in conjuction with STL (p. 17). AETL (2003) asserted that students who can recite factual information are not necessarily progressing toward technological literacy. To achieve technological literacy, the AETL provides educators with guidelines for meeting or developing assessments (p. 20). It is important to highlight that this document does not provide a test, quiz or any other assessment tool and it should be the technology teacher who creates or develops these assessment tools to assess whether students have achieved the desired educational outcomes according to STL.

Assessing Validity and Reliability of a Technology Literacy Instrument

Validity of Achievement Tests

Hopkins and Antes (1985) and Gronlund (1998) classified three types of validity: content, criterion related (includes concurrent and predictive), and construct. Content validity for an achievement test is establishing and demonstrating how closely the content being assessed fits the objectives. According to Gronlund (1998), validity is concerned with the interpretation and use of assessment results (p. 200). Criterion is concerned with test scores or performance and how they are related to an external criterion. There are two types of criterion studies: concurrent and predictive. Concurrent is associated with performance at present time while predictive is associated with performance at a future time. Construct validity is concerned with evidence of what qualities the assessment is measuring. In other words, the measurement should predict how the individual is going to perform in different specific situations. These elements measured include defining what is to be measured as well as a description of the development of the test, the pattern of relationship between test score and other significant variables, and other types of evidence that contribute to the meaning of the test score.

Reliability of Achievement Tests

Gronlund (1998) asserts that reliability refers to the consistency of assessment results from one measurement to another. There are four methods of estimating reliability of test scores: test-retest method, equivalent method, test-retest with equivalent forms, and internal-consistency methods. Test-retest provides the stability of test over a given period of time and requires the administrating the same form of the test to the same group after some time interval. Equivalent-forms method provides the consistency of the test scores over different forms of the test and requires at least two alternative forms of a test to be administered to the same group during the same testing session. Test-retest with equivalent forms provides consistency of test scores over both a time interval and with different forms of the test, and is a combination of the previous two methods. Internal-consistency methods provide consistency of the test scores over different parts of the test and require a single administration test. For the purpose of this study, internal-consistency methods will be use to evaluate the results.

In addition, the AETL (2003) suggests that validity and reliability should be established in technology education consistent with classroom experience. AETL asserts that validity and reliability will be consistent for both formative and summative assessment (p. 23). This implies that teachers will reflect upon the definitions of validity and reliability from the data and several sources (p. 23).

Assessment Methods

AETL (2003) mentions that no single tool or method can "do it all." Assessment of technological literacy should utilize multiple approaches to assess both student cognition and performance (p. 19). The following are 14 sample methods that may be used as assessment approaches. (1) In computerized assessment—the use of a computer is key to measure performance on some attribute, such as visual, problem solving and may not be related to computers and technology. (2) Demonstrations /Presentations/

Multimedia requires students to demontrate and present the result of their design, invention, or created artifact. (3) Individual and group activities require each student to be accountable for their own work and piece of a project in socially distributed expertise networks, organized work, or research by one, two, or more individuals. (4) Informal Observations/Discussions allows students to observe and/or discuss individually or as a group the work and interactions that occur during a problem-solving design process, as well as the interactions with other students. (5) Open-Ended Questioning poses questions to students questions that permit studennts to identify their understanding of the information being taught and attempts to identify student misconceptions and uses that information to adjust instruction. (6) Paper-and-Pencil Testing is an assessment method that allows students to demonstrate their understanding via a multiple-choice test, essay, or other test using paper and pencil. (7) Peer assessment allows students to be evaluated and receive feedback from other classmate(s). (8) Performance Assessment demonstrates how students perform and apply knowledge and assesses what the students know and can do. (9) Portfolios and Work Samples of student work are collected and organized that include results of reasearch, successful and less successful ideas, notes on procedures, and data collected. A portfolio may be in many forms, from photographs depicting student growth and understanding to a socialized electronic journal showing work completed over a period of time. (10) Projects/Products/Media and/or videos/ slide shows/ posters allow students to demonstrate and apply their knowledge and abilities in electronic, poster and/or video format. These may take many forms and are limited by time, resources, and imagination. (11) Reports/Research method demonstrates students' ability to work on a project or topic that will end in a document study. (12)

Rubrics/Checklists is an assessment given to the student with criteria taken from the content standards. Points or words are assigned to each phrase or level of accomplishment. This method provides feedback to the students about their work in key categories, and it can be used to communicate student performance to parents and administrators. (13) Student Interviews (Written and Oral) allow students to demontrate their skills and knowledge in an oral form with a planned sequence of questions. (14) Student Self-Reflection encourages individuals to evaluate themselves in their knowledge, performance, and results of their work (AETL, 2003).

Guidelines for Developing Assessments in Technology Education

The following are guidelines established by AETL and STL that will allow the teacher not only to assess but also to advance technological literacy (AETL, 2003).

In Standard A-1: Assessment of student learning, will be consistent with Standards for Technological Literacy: Content for the Study of Technology (STL). STL articulates what every student should know and be able to do in technology—content that enables students to use, manage, assess, and understand (p. 21).

In Standard A-2: Assessment of student learning, will be explicitly matched to the intended purpose. Effective assessment incorporates a variety of formative and summative practices and provides all students with the opportunity to demonstrate their understanding and abilities (p. 22).

Standard A-3: Assessment of student learning, will be systematic and derived from research-based assessment principles. Like curricula, assessment should be designed to accommodate a variety of levels of developmental and intelligence as well as provide pre-assessment activities to familiarize all students with the content (p. 24).

Standard A-4: Assessment of student learning, will reflect practical contexts consistent with the nature of technology. Students assessment must reflect the active, dynamic nature of the study of technolgy and the manner in which people draw upon and exercise knowledge and abilities acquires through experience (p. 30).

Standard A-5: Assessment of student learning, will incorporate data collection for accountability, professional development, and program enhancement. Assessment involves the process of collecting data, interpreting the results, and reporting the results. The result can be the used to make decisions that directly affect the understanding and development of technological literacy (AETL, 2003, p. 36).

Summary

The goal of technology education always has been to provide students with a set of technological skills that will allow them to function in a technological world. The literature review provided the reader with a brief history of legislation in technology education and its evolution in the last hundred years, from manual training to career and technical education. This review briefly looks at some of the historically significant leaders in the technical education movement who have shaped the contemporary disciplines in vocational and technology education curriculum. Some of those individual were Johann Heinrich Pestalozzi, Victor Della Vos, Dewey, Sloyd, and Woodward, to mention just a few.

Technology education has influenced the development of general education since the early 1800's. The introduction of technological courses has allowed students to develop basic skills, thinking skills, and personal qualities. Consequently, schools have adopted new science and technology programs that benefit students and allow them to understand the connection between technology and science and the relationship with other academic courses. As a result, the technology education curriculum has evolved from a rich tradition of hands-on to team-oriented, project-based learning commonly associated with activities in industrial arts. Through cognitively based models, students participate in elements of learning that emphasize engagement. The technology education curriculum allows students to demonstrate their learning via design activities, production of artifacts, problem solving, and project-based activities. Some of the models reviewed were collaborative learning, socially distributed experience, design/engineering, and project-based instruction.

The development of the Standards for Technological Literacy served as a catalyst with the purpose to guide and articulate what needs to be taught in K-12 laboratory-classrooms. The goal of the STL is to develop higher levels of technological literacy in all students. The purpose of assessment in technology education is to connect effective and appropiate technological literacy assessment practices in conjuntion with the STL. It is essential to understand how the integration of previous knowledge with technology education can lead to the successful understanding of curriculum content and greater academic achievement for students. Guided by a cognitive science approach, it is suggested that technology education capitalize on existing educational curriculum and individual student learning styles to produce higher levels of academic performance. Yet no evaluation tool has been developed to measure technological literacy.

The purpose of this study is to assess and develop an instrument that will help teachers assess students technological literacy after taking courses in the field of technology education. The goal of assessment in technology education is to connect effective and appropriate technological literacy assessment practices with the Standards for Technological Literacy: Content for the Study of Technology.

CHAPTER 3: METHODS

In this study, the challenge of designing and testing a psychometric instrument to measure technology literacy as defined by the STL was undertaken. The research focused on measuring the relationship between student achievement on a technology education literacy test using two groups: students who had instruction in technology education and students who did not.

The specific purpose of this study is to assess the level of technological literacy achieved by eighth-grade students as measured by a self-designed/developed technology literacy instrument correlated with the Standard for Technology Literacy. The study design is a two-group post-test only design that is grounded in the quasi-experimental quantitative research tradition. A post-test is a measure of some attribute or characteristic that is assessed for participants in an experiment after a treatment has been provided (Creswell, 2002, p. 319).

This design uses methods to reduce or not violate statistical assumptions such as normality and homogeneity of variance. Figure 1 shows that this study design used two groups: a control group (G_{2C}) and treatment group (G_{1T}). One group received the treatment, in this case, standards-based technology education instruction consonant with the research recommendations from the cognitive science perspective on learning and instruction (X), and the control group received no standards-based technology education instruction.

G_{1T}	X	O_1
G_{2C}		O_2

Figure 1. The Research Design

This study utilized a quasi-experimental research design, which allowed the researcher to go beyond description and include prediction in order to account for any variances measured by the test instrument. A two-group post-test-only design test was used based on the recommendations of Richard Snow. Snow (1974) asserts that the experimenter must adapt research methodology to fit the form of the phenomenon under study, rather than trying to force the phenomenon to adapt to the experimenter (p. 266). The sample must be representative of the accessible population and it must be clear to the researcher that any aptitude–treatment interactions (ATI's) that may be present could reveal the nature of aptitude for learning and should provide a new key to instruction improvement (p. 271). Finally, Snow recommends that two or more locations should be used when conducting the investigation.

McMillan and Schumacher (1989) state that a post-test-only design with control groups is similar to the one-group post-test-only design in which no treatment or a different treatment is added. At the end of the intervention period, both groups are measured using an instrument that measures the content being studied (dependent variable) (Gliner & Morgan, 2000). In the case of this research proposal, a self-made instrument was used to measure and examine variations of the dependent measure.

Snow (1974) mentions that in designing studies that measure student aptitudes, it is recommended that such studies follow the quasi-experimental tradition. According to Campbell and Stanley (1963), experimental research designs without random selection are called quasi-experimental. A quasi-experimental design study is common in the social sciences. This is particularly true in the case of an educational experiment conducted in the context of a classroom setting that measures student aptitude or academic achievement attainment, like technology literacy. As a result, students are not artificially removed from the classroom, but the experiment is conducted within the environmental flow of the day-to-day school activities (Campbell & Stanley, 1963). In addition, they suggest that a pretest could jeopardize the internal validity of the design, given that students may improve their performance due to their experiences with the pretest.

Cook and Campbell (1979) and Shadish, Cook, and Campbell (2002) assert that the most obvious flaw in a post-test design is the absence of a pretest measure. To avoid problems associated with not including a pretest measure, Cook and Campbell suggest that the use of age, sex, social class, race, place of birth, or residence be substituted for the pretest and used as co-variants in the analysis. In the case of this research, gender was used as a covariate in the analysis.

Procedure

The study was accomplished in four successive phases:

1) Develop a content matrix to identify STL standards with benchmarks and create an item test bank.
2) Establish content validity through expert review of item test bank. All 15 item content reviewers were considered experts in the field of technology education.

3) Pilot test items for reliability and internal consistence and select items for three parallel forms of the test.

4) Select and recruit schools and student sample selection to administer the final instrument.

Instrumentation

Instrument Development

The process of selecting the test bank items began by looking at the five major categories of STL. Each category lays out what each student should learn at four levels, grades K-2, 3-5, 6-8, and 9-12. Each standard and benchmark is related to previous standards and benchmarks that prescribe what a student should know and be able to do to be technologically literate (Standards for Technological Literacy, 2000, p. 12). In addition to the STL categories, 20 benchmarks are organized into grades K-2, 3-5, 6-8, and 9-12, as shown in Figure 2 (Standards for Technological Literacy, 2000).

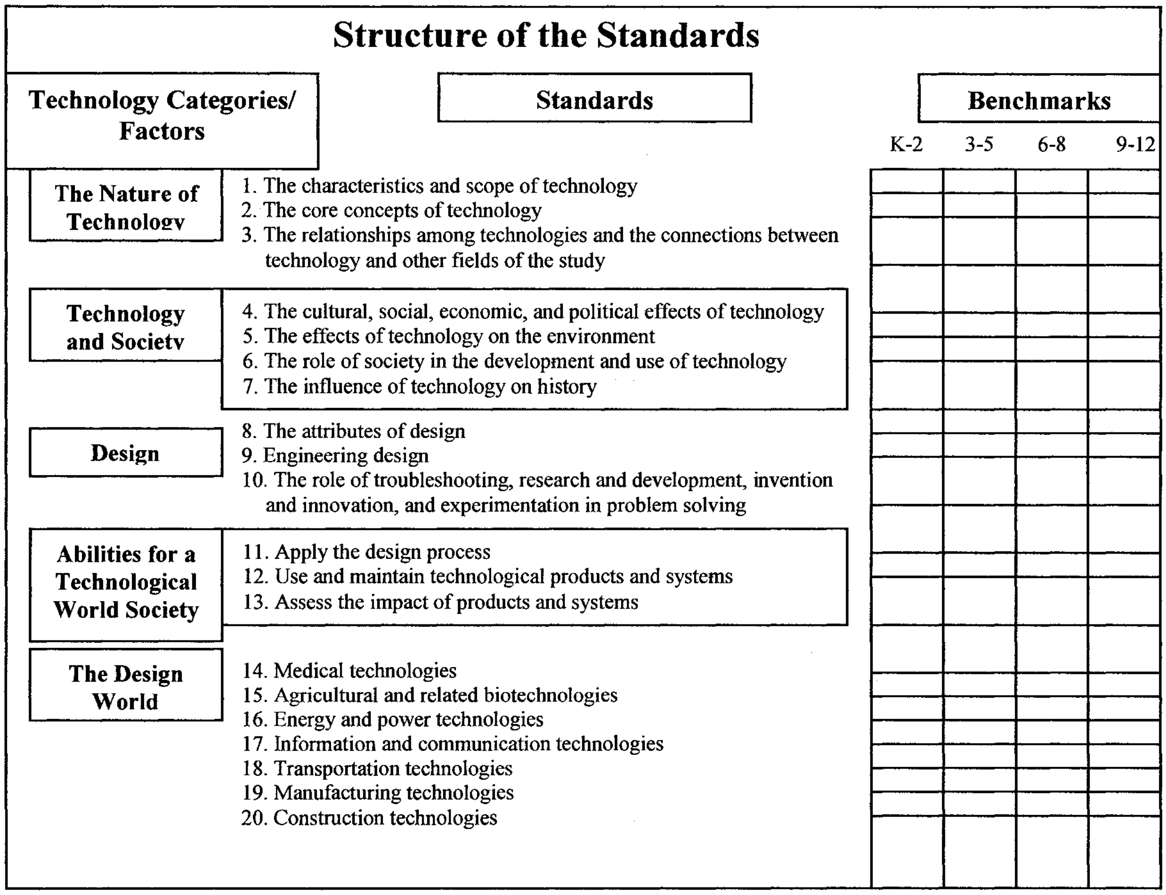

Figure 2. Structure of the Standards

A set of two questions were developed for each benchmark to assess the goal for this category. To maintain content validity, the items selected were matched by the standard and benchmarks at their level of interest. It is important to note that the benchmarks used in the study only included those for grades 6-8.

Standard and Benchmarks Example

For example, in the first category, the Nature of Technology, the first standard states that the students will develop an understanding of the characteristics and scope of technology. The researcher then identified the benchmarks (in this case, there are four) and two questions were created for each benchmark to form a test bank for this standard category. The following benchmarks are what the questions targeted and what students should be learning in this benchmark, according to the Standards for Technological Literacy:

(F) New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology,

(G) The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative,

(H) Technology is closely linked to creativity, which has resulted in innovation, and,

(I) Corporations can often create demand for a product by bringing it onto the market and advertising it.

Form of Assessment

According to Hopkins and Antes (1985) and Gronlund (1998), the construction of a test is made easier if the intended learning outcomes have been clearly defined. In this case, as recommended by the authors, the learning outcomes are the STL benchmarks that have been clearly defined and make the test item specification easier. Gronlund (1998) asserts that the quality of the test will depend on how closely the test maker can match the specifications (p. 42). Hopkins and Antes (1985) and Gronlund (1998) suggest the use of either selecting-type items or supply-type items. In selecting-type items, a set of possible answers is given from which students are to select the most appropriate. For example, multiple choice, true-false, matching, and interpretive exercises are selecting-type items. In supply-type items, the student is required to create and supply their own answer. For example, short answer and essay questions represent supply-type items.

According to Hopkins and Antes (1985) and Gronlund (1998), supply-type items are useful because they require the student to use higher mental processes to arrive at a solution that involves knowledge of facts, cause-and-effect relationships, logical reasoning, critical analysis, and value judgment.

For this particular study, the researcher elected to use the selecting-type items approach, in particular, multiple-choice items were chosen because they are assumed to measure knowledge, comprehension, and application outcomes (Gronlund, 1998, Hopkins & Antes, 1985, Oosterhof, 2003). The Standards for Technological Literacy (2000) was used to develop the test items and the benchmarks served as item specifications.

Guiding Principles for Item Construction

According to Hopkins and Antes (1985), Gronlund (1998), Osterlind (1998), and Oosterhof (2003), multiple-choice test format items have strengths and weaknesses. The strengths have to do with their ability to assess mental attributes. The advantages are that multiple-choice items can be designed to measure students' ability to interpret, discriminate, select, and make applications. Some of the guiding principles when creating multiple-choice test items relate to the creation of the stems. The stems are the statements or questions of the items and should contain a central problem. The items should be practical and realistic, not academic and artificial, and should have four and preferably five independent choices. Items with responses that are obviously wrong should not be included and the inclusion of clues should be avoided. When writing the list of choices, the choices should be on separate lines and when choices include a series of numbers, these choices in should be put in either ascending or descending order. The correct answers should be scattered and when a negative response is wanted, it should be made clear.

Additional strengths of the multiple-choice items are that students need less time to record responses, and the test provides more flexibility for assessing a diversity of content as well as different levels of behavior. Another strength of multiple-choice items is that they are designed to identify an example of a particular concept. Finally, multiple-choice items provide greater test reliability because each question allows for a precise objective interpretation.

Some limitations for multiple-choice items are that constructing good items are difficult and time consuming (Gronlund, 1998, Hopkins & Antes, 1985, Osterlind, 1998, Oosterhof, 2003). Furthermore, multiple-choice items are ineffective in measuring certain types of problem-solving items. They also fall short in capturing items that allow for one and only one answer for every problem.

Instrument Validity

To achieve validity of the research instrument and ultimately the research study, the researcher has relied on establishing content validity. According to Cohen, Manion, and Morrison (2000), content validity shows adequate and representative coverage to which the sample of items on a test are representative of some defined field or domain of content (p. 131).

The researcher developed a content matrix that focused on the five categories of the STL and the 20 benchmarks. The next step was to develop a test bank of items according to the categories and benchmarks in the standards for technological literacy.

Instrumentation Specification

In selecting the bank items, the researcher used the following guiding principles to develop the item. First, the age of the student being tested was taken into consideration. According to Gronlund (1998), the recommended testing time for middle-school students is about 30 to 45 minutes, so the instrument was designed for that timeframe. Second, the time available for testing was taken into account. Gronlund (1998) asserts that typically students at this age answer one multiple-choice question item per minute. In determining the appropriate number of items to be used, Gronlund (1998) suggests that we should use at least 10 items per outcome. Finally, Gronlund (1998) assert that when using fewer than 10 items, only tentative judgment should be made and these judgments should be verified by other means (p. 48).

Test Bank Item Development and Content Matrix across the Standards Benchmarks

The researcher first identified the five standard categories and extracted the 20 benchmarks at the 6-8 grade level. Then the researcher created a matrix to determinate the target. Second, the researcher developed a test item bank that correlated or addressed those targets. Once the test item bank was developed with questions matching the standards and benchmarks requirements, the researcher randomly selected two questions for each benchmark and submitted the test to experts for content validity review.

Reading Level

In the United States, the readability test most widely used in the field of education is the Flesch-Kincaid grade level. The “Flesch-Kincaid Grade Level Formula” translates the 0-100 score to a U.S. grade level, making it easier for teachers, parents, librarians, and others to judge the readability level of various books and texts.

$$(.39 \text{ x ASL}) + (11.8 \text{ x ASW}) - 15.59$$

The result is a number that corresponds with a grade level. For example, a score of 7.1 would indicate that the text would be understandable by an average student in seventh grade.

The researcher was instructed to pay close attention to the wording of items to guarantee that the use of language was clear, simple to understand, and appropriate for an eighth-grade reading level. The researcher used the Flesch Reading Ease scale and the Flesch-Kincaid Grade scale to determine the reading level in the test and the difficulty level. The way that the Flesch Reading Ease scale works is by using the following formula:

$$206.835 - (1.015 \text{ x (ASL)} - (84.6 \text{ x ASW})$$

(ASL) Where total syllables/total words = Average number of Syllables per Word (ASW) and total words/total sentences = Average Sentence Length (ASL)

Content Validity Review Phase

In this phase, the researcher gathered evidence in two forms, first, from a panel of fifteen experts from outside of Colorado State University who were knowledgeable about of the integration of technology education into curricula. Huck (2004) states that content validity is determined by having experts compare the target benchmarks to items, stem statements, and answer choices. The items were grouped by benchmark so the evaluator will be able to read the benchmark and compare the item, stem statement, and answer choices to the benchmark to determine content alignment. The experts were asked to evaluate the content of the test items against the benchmark. The content expert was then asked to review the benchmarks on three criteria:

1) Clarity and readability of each item,

2) Relationship of the question to the STL grade 6-8 benchmarks and appropriateness and,

3) Difficulty of the items for a grade 6-8 learner in technology education.

The content experts were then asked to reflect on the clarity and readability of the item. Qualitative feedback was sought on questions such as; Does the question make sense? Are the available answers appropriately related to the stem? Will it make sense to an eighth-grade student? The experts were asked to gage the validity of the relationship of the question to the STL 6-8 benchmarks. The content experts were asked to read the question, read the content of the stem and the appropriate answer, and then relate that item to the appropriate benchmark. The content expert was questioned as to the relevancy of the benchmark to the content. The experts were asked to assess whether the third criteria, appropriateness of the question, corresponded to the benchmark and whether it may or may not be too difficult. In this last area, the content expert was asked if the language used, the reliability, and the organization of the question related to the benchmark and whether it was appropriate for a grade 6-8 learner in technology education. Content experts were provided with an evaluation and feedback form.

Content Validity Procedure

The procedure began by sending an email requesting expert participation. The content experts were identified and selected from nationally recognized technology teacher education programs and were identified using the national directory published by the Council on Technology Teacher Education. The experts selected to serve as content validation experts also had participated in the review of the national STL and were university professors and middle school teacher experts. These criteria ensured a deep knowledge of STL and the benchmarks for each standard. Once the 15 experts (ten university professors and five middle school teachers), agreed to participate, a second letter, the test bank items, and instructions with an evaluation instrument for the test bank items developed by the researcher was included in a package. The researcher asked the expert panel to return the evaluation package within two weeks. When the evaluation packages were returned, the researcher looked for commonalities in the review responses and vetting of undesirable items. The researcher examined comments and suggestions and made corrections suggested by the content review experts. Based on the evaluative feedback, a pilot test item bank was established.

Pilot test and Item Analysis Phase

The researcher next performed a pilot study to develop, adapt, and check the feasibility of techniques, determine the reliability of measures, and to calculate how big the final sample needed to be. The pilot test consisted of three parallel forms, A, B and C, with 35 questions each derived from the item test bank. The item test bank consisted of 172 items covering the grade 6-8 standards and benchmarks. The parallel forms tests were constructed to reduce test fatigue and keep the assessment completion time appropriate for the grade level in which it was administered. The purpose of the pilot testing was to see how the items performed, whether high correlation existed, if question unstable, and if students understood the test. The three parallel forms pilot test was administered to 86 middle school students who had not taken technology education classes. Each test form was taken by at least 26 students in the pilot test sample.

To obtain reliability of the instrument, the researcher used the coefficient alpha as the index of reliability. The Kuder-Richardson formula 20 (KR20) was used for estimating the test reliability. This test is appropriate because when items on an instrument are scored as right, wrong, or categorical scores, the responses are not influenced by speed, and the items measure a common factor (Creswell, 2002, p. 182). This coefficient is a key factor in the operational measurement of homogeneity among test items (Cronbach, 1951) and must be established prior to the study. The researcher was guided by the reliability of an instrument to be mostly high (above .80) while marginally acceptable (above .60) for a few items (Gliner & Morgan, 2000).

In addition, a correlation (conceptual) factor analysis was used to evaluate the test, and involves item analysis, scale development, and theory testing. The conceptual factor analysis using the inter-item correlations was conducted, as opposed to a traditional principal component factor analysis because each benchmark was assigned on two items to attend to length of instrument. In order to properly conduct a factor analysis, three or more items per factor (benchmark) is required. The correlational (conceptual) factor analysis is the process of combining a number of items or variables to form a smaller number of composite variables (called factors or components) (Gliner & Morgan, 2000). In other words, correlational (conceptual) factor analysis shows what variables, groups, or test items go together and which do not by using data supplied by the correlation matrix. This process required that each item be individually assessed against every other item in the test item bank in addition to looking at the item correlation within each benchmark. In this case, the researcher found correlations of factors related to the STL categories (5) and benchmark (82).

After the conceptual correlation was established, the researcher ran a correlation analysis to determine if the item questions were not correlated to each category and/or benchmarks. The distribution of the five categories are as follows: Category 1 has three Standards with thirteen benchmarks, Category 2 has four Standards with fifteen benchmarks, Category 3 has three Standards with nine benchmarks, Category 4 has three Standards with thirteen benchmarks, and Category 5 has seven Standard with thirty-two benchmarks as shown in Figure 3.

Form A	Stan 1(1-3)	Stan 2(4-7)	Stan 3(8-10)	Stan 4(11-13)	Stan 5(14-20)
	0101F	2506D	4110H	4812J	7716G
	0802P	3007E	3609G	5213G	8219K
	0902Q	3107E	4010G	4511K	7117J
	1202T		3901F	5412I	5514H
	1703F			5012K	5614H
	1603E			4211H	6816I
					8019I
					5914G
					5814J
					8420G
					6516F
					7318F
					7217K
					6416E
					8620I
					7819H

Figure 3. Item Loading on Standards and Benchmarks

Schools: Control and Experimental

This quantitative study examined the relationship and effect of two types of instruction on student technological literacy. The four schools selected for this study were middle schools that have an eighth-grade level. Two schools deliver technology education instruction and the control schools do not deliver technology education courses. Both control and experimental schools are part of the Los Angeles Unified School District (LAUSD) in California. Moreover, the schools are demographically similar. For example, the school district enrolls a large multicultural and diverse ethnic student population. The average student population in the schools range from 1,044 students to 2,807 students, where the average number of English-language learners per school ranged from 267 students to 1,524 students. The most important criterion in finding an appropriate population was whether the comprehensive public middle school offered technology education classes.

Technology Education Programs

Schools offering technology education programs in this study needed to be implementing curriculum aligned with the Standard for Technological Literacy (STL). The curriculum should be directed toward delivering the Standards for Technological Literacy as opposed to a vocational curriculum. The courses must have modular curriculum delivery methods and a class rotation schedule of instruction that ensures all students were exposed to the curriculum equally.

Students

The student population eligible for the study comprised middle-school students who are currently in the eighth grade, who have had at least one semester of technology education, either in the seventh grade or early eighth grade. The rationale for this selection was that in the majority of middle schools, technology education is a required elective in the seventh grade. The racial/ethnic background of the students includes Hispanics, White, Asian, and African-American; in most of the schools selected, Hispanic students comprise the majority of the school population. Convenience sampling was used in this study. Students are assigned to classes by the registration office when they enter middle school. Students assigned to a technology class formed the experimental group. The non-treatment control group was students who did not take a technology education class but possess a similar educational and demographic background.

Teachers and Curriculum

The teachers selected for this study have a teaching background in the field of technology education. They must have earned a credential/license in technology education or industrial arts to participate in this study. In addition, to be eligible for participation, needed to have three years of teaching experience at the middle grade level. The rational for this teacher selection criterion was to avoid the interjection of teacher effects into the results. Teacher effects if found could seriously violate the assumptions under the general linear model.

The teaching curriculum needed to be in a modular classroom/lab. In a modular classroom/lab, students are provided with a learning module that explores physical science, technology, and design concepts. Also in a modular lab, the students work in teams of two or three in a learning unit or center (module), where they master the material through a combination of hands-on exercises and multimedia computer instructions.

The learning unit may include multimedia instruction, video, guidebook/workbooks that guide students through the activity. Students work an average of seven to ten instructional days in the module, which includes seatwork, worksheets, interacting web-based instruction, Digital Video Discs, and hands-on experiments. Students have periodic tests or assessments about the unit and complete a final project—a design brief. The design brief represents the final or culminating activity designed to engage the student in problem solving and to demonstrate their application and knowledge learned in the module. At the end of the instructional module, the students present the result of their final design brief project, and then the students rotate to the next learning module. When the students rotate to a new curriculum module, students may retain their partner or assume a new student partner. Topics/areas of study in a modular environment investigate several areas of technology, ranging from transportation, construction, manufacturing, communication, and environmental, each aligned to STL.

Group Selection

The participants for this study included those students who took a technology education class (n = 135) by the end of the fall semester of 2006 and a comparison control group of students who did not take a technology education class (n = 137) at a different school. The middle schools were purposefully chosen for this research because of access and geographical location (see Table 1, control and experimental group schools). The selected schools were located in two geographically diverse locations in the LAUSD that represent the experimental group, and two in the control group. The goal of the group selection was to administer the technology literacy instrument to 50 students per school, which is the equivalent of two classes.

Table 1. Control and Experimental Group Schools

School		Address
Experimental		
Griffith MS		4765 E. Fourth St., Los Angeles, CA 90022
Stevenson MS		725 S. Indiana St., Los Angeles, CA 90023
Control		
Belvedere MS		312 N. Record Ave., Los Angeles, CA 90063
Hollenbeck MS		2510 E. Sixth St., Los Angeles, CA 90023

Table 1 shows the two groups of experimental and control schools selected. The experimental group contains two middle schools and the control contains two middle schools. The sample was drawn from 68 students from each school, which is the equivalent of having N=135 in each group.

Research Procedures

School Selection

Human Subject Committee's approval was obtained from Colorado State University Office of Regulatory Compliance (See Appendix B) before the research began. Once the schools were selected, the researcher contacted the administrator and teachers in charge of the school and classroom and asked permission for their school and class participation. A permission letter was sent for approval to the school principal and teachers for participation. The schools and teachers were selected based on the criteria in the sample discussion. The researcher also created the necessary forms to request permission from parents, students, and schools to participate in this study (informed consent). Assurance that names of respondents and school would remain anonymous was made clear to the participants. Finally, a cover letter was provided with information regarding the technological literacy test.

Teacher Selection

Once the schools were selected and approval from the school administrator granted, a permission letter was disseminated to qualifying teachers requesting permission to use his/her class and students for the study. This letter also explained to them what the research entails and how their participation is very important for the field of education, especially technology education. The researcher also provided the teacher with instructions on how to administer the test and the necessary forms, such as consent forms and information that the student needed to take home and share with their parents since they are under 18 years old. The forms needed to be signed and turned in to the teacher before the study begun. Once the consent forms and information form were collected, the researcher scheduled a time to administer the test.

Student Selection

The students selected to participate in the study were selected based on three criteria. First, each student was required to have a technology course for one semester. Second, each student was required to be at the eighth-grade level at the beginning of this study. The third and last criterion for selecting the students was demographics to ensure a diverse student population. Participants were informed about the purpose of the study and what was required of their participation. Participants were asked to take home a consent form, review it with their parents, and have them sign and return it to their teacher in order to participate in the study. The consent form described the study, the benefits of their participation and their rights as research participants (see Appendix B). If participants agreed to participate in the study, the researcher provided the participants with two consent forms. The first consent form was for the participant and their parents or guardians to sign and return to the researcher and the second was for the participants to keep.

Test Administration and Data Organization

The final technology literacy test was administered between the dates of December 4, 2006 and December 8, 2006. In total 137 students were administered the test in the control group and 135 were administered the test in the experimental group. All tests were administered by the qualified teachers after confirmation of receipt of the student assent form and parent consent form that was then matched to the official class role to ensure compliance to human subjects research protocol. The final test packets were collected by the researcher from each teacher and placed in individual envelopes to ensure each was accompanied by student and parent consent forms along with teacher and school administration consent forms.

Following the collection of the test forms from the participating teachers, the data was coded and entered into a Statistical Program for the Social Sciences (SPSS 15.0) data files for cleaning and screening. No identifiable coding was used to trace individual test scores to individual students. This was not necessary since the focus of the research was on instrument performance and the ability of a valid instrument to detect differences in student achievement in the study of technology. The raw data test forms were then locked in a secure storage in the possession of the Principal Investigator for the required time under the guidelines of the Colorado State Office of Regulatory Compliance.

CHAPTER 4: FINDINGS

Introduction

The purpose of this study was to design, construct, and test an instrument that could assess the level of technological literacy achieved by eighth-grade students as measured by a self-designed/developed technology literacy instrument correlated with the Standards for Technology Literacy. The researcher administrated a self-made technological test to students who took a technology class (experimental group) and students who did not take a technology class (control group). This chapter reports the findings of the study in the form of statistical data.

This chapter presents the descriptive analysis, reliability findings for the instrument designed in this study, and the findings from an analysis of variance (ANOVA) conducted from data collected in both the experimental and control group. The statistical analysis was performed using the Statistical Package for Social Science (SPSS for Windows) release 15.1. The statistical procedures in this analysis were conducted to test the null hypothesis that students who took a technology class had no significant mean difference in performance scores from students who did not take a technology class. In addition, the researcher was seeking to detect if students who took a technology class were more technologically literate than students who did not take a technology class as measured by the psychometric instrument designed in this study.

Pilot Instrument Findings

The building of the instrument began with the development of a set of two questions correlated to each benchmark to assess the goal for each standard category. To maintain content validity, the items created were matched to the standard and benchmarks at the grade level of interest. Following the initial item construction phase, the researcher sent emails requesting content expert participation. Once the experts agreed to participate, a second letter, the test bank items, and instructions with an evaluation instrument for the test bank items developed by the researcher was included in a package. The researcher asked the expert panel to return the evaluation package within two weeks. When the evaluation packages were returned, the researcher looked for commonalities in undesirable items. The researcher examined comments and suggestions and made any corrections needed. Based on the feedback received from the content validation experts, a pilot test was constructed from the 172 items in the item test bank.

The researcher next performed a pilot study to develop, adapt, and check the feasibility of administration techniques, determine the reliability of measures, and to calculate the final sample size desired to achieve sufficient statistical rigor. The researcher used the same sampling procedure and techniques as in the larger study. The pilot test consisted of three parallel forms, A , B and C, with 35 questions each, and was administered to 86 middle school students who had not taken technology education classes. The researcher created the three test forms by using a random-number-generator program to select the questions from the 172 questions test item bank. By using random number generator, the researcher was able to create three forms of a 35-question test. The test length and student age were important factors in deciding to create the test forms. Testing an instrument with 172 questions in a middle grade setting was determined not to be methodologically sound. The pilot test was distributed to the 86 students, which was equivalent in size to three classes. At the end of the pilot test, form

A was found to be the most stable test form of 35 items because of better reliability and inter-item statistics. The descriptive data and the reliability information for forms A, B, and C tested are presented in Table 2.

Table 2. Comparison of Reliability Statistics for Forms A, B, and C

Form	N	Cronbach's Alpha
Form A	35	.80
Form B	35	.45
Form C	35	.64

To obtain reliability of the instrument, the researcher used the coefficient alpha as the index of reliability. The researcher determined reliability of the instrument to be relatively high (above .80), while marginally acceptable (above .60) for a few items (Gliner & Morgan, 2000).

In addition, factor analysis was used to evaluate the test, which involves item analysis, scale development, and theory testing. Factor analysis is the process of combining a number of items or variables to form a smaller number of composite variables (called factors or components) (Gliner & Morgan, 2000). In other words, factor analysis shows what variables, groups, or test items go together. In this case, the researcher found correlations of factors related to the STL categories.

The researcher analyzed the correlation between each individual category and benchmarks to determine if the item questions were not correlated. The researcher performed a no traditional factor analysis, but it was performed conceptually. The researcher took stable items that measured the standards and the benchmarks placed within. Conceptually, they are all in categories but not correlated because they are measuring different benchmarks. In category one, the reason for the low correlation is because they are measuring different benchmarks. Since the researcher randomly selected the questions, there may be some correlated questions. For example, in category one, items 1202T is correlated with item 0802Q and item 1703F is correlated with item 0902Q because those two items measure a benchmark related to the other one benchmark as shown in Table 3.

Table 3.

Correlation between Category 1 Standards 1-3 and their Benchmarks

Subscale	0101F	0802P	0902Q	1202T	1703F	1603E
		Items	(n=6)			
0101F						
0802P	.273					
0902Q	.730	.062				
1202T	.348	.014	.163			
1703F	.651	.171	.025	.891		
1603E	.612	.818	.547	.265	.983	

Category two is not highly correlated because they are measuring different benchmarks. The correlation data for Standards 4-7 are presented in Table 4.

Table 4

Correlation between Category 2 Standards 4-7 and their Benchmarks

Subscale	2506D	3007E	3107E
	Items	(n=3)	
2506D			
3007E	.181		
3107E	.943	.875	

Category three is not highly correlated because they are measuring different benchmarks. The correlation data for Standards 8-10 are presented in Table 5.

Table 5

Correlation between Category 3 Standards 8-10 and their Benchmarks

Subscale	4110H	3609G	4010G	3910F
4110H				
3609G	.488			
4010G	.368	.962		
3910F	.320	.121	.726	

Category four is not highly correlated is because they are measuring different benchmark. Since the researcher randomly selected the questions, there may be some correlated questions. For example, in Standards 11-13, items 4211H is correlated with item 4511K, item 4211H is correlated with item 5412I, and item 4211H is correlated with item 5012K because those three items measure a benchmark related to the other one benchmark. The correlation data for Standards 11-134 are presented in Table 6.

Table 6

Correlation between Standards 11-13 and their Benchmarks

Subscale	4812J	5213G	4511K	5412I	5012K	4211H
4812J						
5213G	.159					
4511K	.110	.074				
5412I	.214	.673	.094			
5012K	.848	.382	.548	.557		
4211H	.114	.370	.013	.000	.013	

While there are sixteen Standards, the reason they are not highly correlated is because they are measuring different benchmarks related to Standards 14-20. Since the researcher randomly selected the questions, there may be some questions that may be correlated. For example in Standard five, item 8219K is correlated with item 7719G, item 5614H is correlated with item 8219K, item 6816I is correlated with item 6816I, item 8018I is correlated with item 7719G, item 5914G is correlated with items 7719G, 8219K, and 6816I, item 5814J is correlated with items 8219K, 5514H, 5914G, and 5814J, item 6516F is related with items 6816I, and 8420G, and item 7819H is correlated with item 8219. Those items that are correlated because they are measuring items related to the other benchmarks. Many items have high correlation within each other because in this particular category 5, the design world, many benchmarks overlap within each other in areas such as transportation, communication, manufacturing, just to mention a few. The correlation data for Standards 14-20 are presented in Table 7.

Table 7

Correlation between Standard 14-20 and their Benchmarks

Subscale	7719G	8219K	7117J	5514H	6816I	8018I	5914G	5814J	8420G	6516F	6516F	7318F	7217K	6416E	8620I	7819H
7719G																
8219K	.014															
7117J	.354	.416														
5514H	.103	.573	.816													
5614H	.109	.042	.878	.968												
6816I	.821	.396	.375	.951	.002											
8018I	.002	.572	.666	.537	.608	.673										
5914G	.026	.001	.781	.303	.001	.110	.242									
5814J	.874	.004	.299	.018	.486	.528	.004	.013								
8420G	.675	.705	.781	.139	.992	.110	.123	.588	.331							
6516F	.701	.171	.583	.591	.057	.192	.484	.496	.022	.496						
7318F	.130	.557	.227	.774	.898	.785	.224	.062	.569	.668	.085					
7217K	.567	.841	.059	.372	.888	.159	.874	.278	.939	.278	.357	.554				
6416E	.911	.841	.353	.154	.746	.620	.173	.278	.668	.278	.960	.279	.796			
8620I	.701	.171	.198	.933	.396	.922	.743	.094	.227	.798	.289	.218	.960	.357		
7819H	.294	.031	.340	.556	.749	.181	.411	.347	.652	.679	.228	.423	.696	.696	.892	

Final Test Data Analysis

Sample Descriptive Statistics

The subjects were selected from four middle schools who took a technology literacy test created by the researcher. The total number of participants in this study was 272 eighth grade students. The study sample size of 272 represents a sample sufficient for attaining results with a 95% confidence level with a confidence interval of $\pm$2.59%. The total number of students who took the test with technology education classes was 135. The total number of students who took the test with no technology education classes was 137. All participants were tested by the same post-test instrument and with an equal amount of allotted test time. The scores were then compared with frequency count of percentages using mean, median and standard deviation measurement for the total group of participants. The participant's genders were evenly distributed 50% (N=135) females and 50% (N=137) males. Table 8 shows the sample descriptive data across gender between the experimental and control group.

Table 8. Gender of Participants in the Study

Gender of Participants	Frequency	Percent
Female	135	50
Male	137	50
N	272	100

The purpose of this study was to measure the impact of instruction in technology education and if instruction of technology education instruction is enhancing students' technological literacy in the eighth grade level guided by the Standards for Technological Literacy (STL). The total possible score on the test was 35. Table 9 shows that the mean score of students who took a technology class was higher than those who did not took a technology class. Further descriptive analysis indicated that the test for homogeneity of variance was non-significant, meaning that the sample exhibited characteristics of normality required for analysis under the assumptions of the general linear model as shown in Table 10. The Levene's test for equality of variances achieved no statistical significance, $F(1, 270)=4.40$, $p=.41$. The levene's test confirmed that the study sample did not violate the assumption of normality, which confirmed that the sample is normally distributed. Univariate normality was tested and skewness and kurtosis statistics were well within acceptable limits; a visual inspection of the univariate frequency distribution and Q-Q plots showed no exceptions to this judgment of unvariate normality. However, none of the skewness and kurtosis statistics was unreasonably high and given the relatively large sample sizes, it was concluded that no transformations were necessary.

Table 9. Test Score Statistics

Post-test	Technology Education	No Technology Education
Population	135	137
Mean	15.42	14.07
SD	5.42	5.25

Table 10. Test of Homogeneity of Variances in Scores

Levene Statistic	df1	df2	Sig.
.665	.087	271	.931

The descriptive data and the comparison of measures of central tendency show that the eighth-grade participants taking a technology education class scored higher on the technological literacy test (*M*=15.42, *SD*=5.42) than those who had no previous technology class exposure; they had a mean of M=14.07, SD=5.25).

Analysis of Variance

To analyze the variation in student scores collected on the technological literacy measure an ANOVA test was used to determine if there were significant mean differences between group scores. A two-tailed test was applied to the data and scores were analyzed for significance of difference. The purpose of this test was to determine if there was a significant difference between the mean score in the post-test between the two groups. A significant difference between the mean score using an alpha level .05 was detected. A one-way analysis of variance using the post-test between groups and within groups of the eighth-grade participants was performed. The results of this analysis are shown in Table 11. The results indicated that there was significant difference between the experimental and control group in this study.

Table 11. ANOVA

Group	N	Mean	Std. Deviation	Std. Error
Tech	135	15.42	5.42	.47
No Tech	137	14.07	5.25	.45
Total	272	14.74	5.37	.32

A one-way between-groups analysis of variance (ANOVA) was performed using post-test between groups and within groups of the eighth-grade participants. Comparing the means of the eighth-graders post-test scores, there was found to be significant difference $F(1, 270)=4.40$, $p=.037$ as shown in Table 12.

Table 12. Analysis of Variance between Groups

Variance	Sum of Squares	Df	Mean Square	F	Sig.	d
Between Groups	125.13	1	125.12	4.40	.037	.253
Within Groups	7679.34	270	28.44			
Total	7804.47	271				

The Cohen *d* statistic of .253 in Table 12 above is derived from the group mean differences and standard deviation to calculate the effect size (Gliner & Morgan, 2000). The results of this analysis indicate that the technology education instruction or treatment had a small to medium effect on the overall performance of the students in this sample.

Gender

A one-way between groups ANOVA was performed to determine if male and female scores differed on the technology literacy test. The results indicated that there was no significant difference in gender scores on the standardized technology literacy test from the males (N=134, M=14.79, SD=5.55) compared with the females (N=138, M=14.69, SD=5.20), as illustrated in Table 13.

Table 13. Comparative Scores between Males and Females

	N	Mean	Std. Deviation	Std Error
Males	134	14.79	5.55	.48
Females	138	14.69	5.20	.44
Total	272	14.74	5.37	.36

The univariate results were within acceptable limits. A Levene's test for equality of variances achieved no statistical significance, $F(1, 270)$=0.3, p=.17, as shown in Table 14.

Table 14. Test of Homogeneity of Variances in Scores

Levene Statistic	df1	df2	Sig.
1.885	1	270	.171

Univariate normality was tested and skewness and kurtosis statistics were well within acceptable limits; a visual inspection of the univariate frequency distribution and

Q-Q plots showed no exceptions to this judgment of unvariate normality. However, none of the skewness and kurtosis statistics was unreasonably high and given the relatively large sample sizes, it was concluded that no transformations were necessary.

Finally, a one-way between-groups analysis of variance (ANOVA) was performed using post-test between and within the two test groups of the eighth-grade participants—those who had technology education instruction and those who did not (see Table 15). A close examination of the means of the eighth-graders' post-tests shows there was not a significant difference between and within groups across gender, $F(1, 270)=4.40$, $p=.88$.

Table 15. One-way Analysis of Variance between Test Groups across Gender

	Sum of Squares	Df	Mean Square	F	Sig.
Between Group	.72	1	.72	.03	.875
Within Groups	7803.75	270	28.90		
Total	7804.47	271			

Summary of Hypothesis Findings

In conclusion, the researcher found that eighth-grade participants completing a technology education class performed better on the test instrument (M=15.42, SD=5.42) than those who had no previous technology classes (M=14.07, SD=5.25). Based on the results of the data analysis, the researcher will reject the H_0 for the first hypothesis established early in the study, therefore;

H_0: There is no significant impact on students who took a technology education class compared with those who did not take a technology education class will be rejected, and;

H_1: There is a significant impact on students who took a technology education class compared with those who did not take a technology education class will be accepted.

The result of this study show that there is a significant difference in student technology literacy as measured by the instrument developed and tested between students who completed a technology education class compared with those who did not take a technology education course.

The second hypothesis in this study was tested to determine if differences exist across gender. The following hypothesis was tested.

H_0: There is no significant difference between male and female students who studied technology education as measured by the technology literacy test designed and tested in this study.

H_1: There is a significant difference between male and female students who studied technology education as measured by the technology literacy test designed and tested in this study.

The results indicated that there was no significant difference in gender scores on the standardized technology literacy test (N=134, M=14.79, SD=5.55) between males and females (N=138, M=14.69, SD=5.20), therefore H_0 is retained.

The sample group for this study was 272 students and the conclusion is only intended to apply to this small group. However, the study was designed to compare and assess the level of technological literacy achieved by eighth-grade students as measured by a self-designed/developed technology literacy instrument correlated with the Standards for Technology Literacy. The reader is open to judge if the findings, though significant, have a likely connection within a context of technology literacy. The researcher believes there is significance to this study and future research may develop or generate a standard technological assessment instrument tool that will assess the level of technological literacy in each student.

CHAPTER 5

DISCUSSION, SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Technology education as discussed and characterized in this study has being emerging in schools since at least 1985. The Standards for Technological Literacy (STL) were released in 2000 by the International Technology Education Association's Technology for All Americans Project (ITEA-TfAAP) and has served as a catalyst for change and direction for the field (Standards for Technological Literacy, 2000, p. vii). However, to date no psychometric measure has been designed and tested to measure the level of technological literacy attained by students based on the content and benchmarks specified in the standards.

The STL content standards are organized into five major content categories. Each category presents the content of what each student should know at four levels, grades K-2, 3-5, 6-8, and 9-12; the content is identified by an alphabetical listing (e.g., A, B, C) (Standards for Technological Literacy, 2000). According to the STL, each standard and benchmark has a connection from previous grade-level standards and benchmarks for the purpose of building and prescribing what a student should know and the able to do to become technologically literate (p. 12). The content categories are organized into 20 standards; each individual standard has two components: what students should know and understand about technology and what they should be able to do. The benchmarks that accompany each standard provide the fundamental content elements for the broadly stated standards. The development of a test instrument that can measure technological literacy across each grade-level benchmark would represent a depth and scope that would be nearly impossible or impractical to attempt to measure in a single assessment instrument. Therefore, an important transition point in general education is generally recognized at the eighth grade level, which was a reason why the eighth-grade was selected for this study. The eighth-grade STL contains 20 standards with 84 benchmarks. This number of standards and benchmarks alone represents a significant challenge in developing a valid and reliable assessment tool. Therefore, with the defined scope of content and benchmarks in STL as the guide and the eighth-grade specifications as the assessment target this study set out to validate and test a psychometric tool to detect student achievement in the study of technology.

As noted in appendix D, five categories are broken down into generalized standards. For example, section I, the nature of technology, which contains three standards. However, the standards are referenced by grade level and organized from six through 8th grade level. Each level has standards, and if each standard has three or more benchmark elements, the total amount of questions can add up to 54 item questions for the first standard. There is no doubt that this investigation can indeed serve the field of technology education as a starting point to bring valid and reliable assessment data that measures a difficult knowledge set such as technology literacy. This study hopes to establish that when selected standards and benchmarks for student achievement are identified, they can indeed be measured. A significant qualification of this statement is that when multiple content categories (5) and standards (20) as represented in STL, the challenge to design and test a psychometric tool becomes exponential in difficulty. The challenges in designing and testing a practical assessment tool requires the researcher to make critical decisions such as reading level content, length of test, age of the students, and item design and specifications, which benchmarks to target if not all each weigh into the decision-making process. As instrument specifications are built while taking into account the limitations, it slowly whittles away at content validity and reliability. Therefore, the researcher in this study experienced the traditional struggles of psychometric instrument development. This has led me to realize that no one is immune to these difficulties in conducting educational research; according to David Berliner, educational research is indeed the hardest science of them all.

Summary

The purpose of this study was to design and test a psychometric tool to measure the impact of instruction in technology education and to detect whether technology education instruction is enhancing students' technological literacy at the eighth-grade level as guided by the Standards for Technological Literacy (STL) and measured by this exploratory instrument. Chapter 2 guided the reader through a contextual background of relevant literature that helped to build an understanding of the field of technology education and the need for the development of an instrument correlated with the Standards for Technological Literacy (STL). The literature review briefly presented the evolution of technology education from its historical roots and the modern relationship between cognitive science and technology education as a powerful connection in enhancing student leaning in the 6-8 grade level.

The study used a post-test only quasi-experimental research design coupled with an additional research element that required the design, validation and testing of a self-made instrument to assess technology literacy. A172-question bank test instrument was designed, created, reviewed, and items selected with outside validation and support from a panel of recognized experts in the field of technology education. The guiding principles for the instrument design and construction were fully informed by the Standards for Technological Literacy: Content for the study of technology.

The study was designed to assess the level of technological literacy achieved by eighth-grade students as measured by a self-designed/developed technology literacy instrument correlated with the Standards of Technology Literacy. Students took the test derived from randomly selected items from the test bank during the first week in December of 2006, which was the end of their fall semester. The sample was drawn from a modular technology education program that implemented a program with a common set of modular provided by a commercial vendor. The teachers selected for this study have a teaching background in the field of technology education. They must have earned a credential/license in technology education or industrial arts to participate in this study. In addition, eligible participants, needed to have three years of teaching experience at the middle grade level. All 272 sample participant data was compiled and statistically analyzed by the researcher. The goals of the analysis were to detect if there was a difference between students who took a technology class compared with those who did not take a technology class. To inform this research the researcher used a simple quantitative analytical approach that included descriptive statistics such as means, standard deviation, percentage, and frequency. In addition, the hypothesis presented was tested using analysis of variance techniques. Tables were constructed to communicate the study findings and to summarize the results from the analysis of the data. Two essential results can be concluded from this study. First, students in this sample who did indeed take and complete a technology education course that was standards-based and delivered in a modular format performed at a statistically higher level than those students who never experienced a technology education course as measured by the assessment instrument designed and tested in this study. Second, the results of this study indicate that the variance distribution of the student scores in this sample was indeed normally distributed and that gender of the students did not statistically affect their scores. In other words, both male and female students scored equally in both groups tested.

The results of this study indicate that there is promise in demonstrating that instruction in technology education can influence a student's level of knowledge/literacy in the subject. The problem is that the effect size is small and the lack gain of detection is not going to be done effectively unless multiple assessment methods are used, such as test, performance, portfolios, and projects in a holistic assessment model. While the field of technology education is not quite there yet, an important step that this study provided in its attempt was the creation of a reliable and valid instrument. Hoepfl (2007) stated that a balanced and comprehensive assessment plan will likely include both traditional and alternative measures of student capability (p. 65).While the results of this study can only be considered exploratory, much work remains in optimizing the instruments and grade-level target desired to be measured. This study selected only the eighth-grade content standards and benchmarks to serve as a test bed or proof-of-concept that a reliable and valid psychometric instrument can be designed and tested. This study was not intended to be a sole measurement instrument for technological literacy, but one piece of an important segment or approach.

Conclusion

The purpose of this study was to measure the impact of instruction in technology education to determine if technology education instruction guided by the Standards for

Technological Literacy (STL) is enhancing students' technological literacy at the eighth-grade level. Therefore, the hypotheses to explore in this study were:

H_0: There is no significant impact on students who took a technology education class compared with those who did not take a technology education class.

H_1: There is a significant impact on students who took a technology education class compared with those who did not take a technology education class.

Before rejecting H_0 and accepting H_1 as the results suggest, the researcher acknowledges that this study is limited to only four middle schools located in Southern California. Obviously, additional sources of information such as those provided by a larger study or an additional instrument could have improved the study.

The results gained in the study found that there is a significant impact on students who took a technology education class compared with those who did not take a technology education class. The eighth-grade participants taking a technology class performed better (M=15.42, SD=5.42) than those who had no previous technology education curricular exposure (M=14.07, SD=5.25). Comparing the means of the eighth-graders' post-test, there was a significant difference between their technological literacy achievement on the self-made instrument used in this inquiry as compared to students who had no exposure to the study of technology $F(1, 270)=4.40$, $p=.037$, $p<.05$.

The second hypothesis states that there not a significant difference between males and females who studied technology education classes.

H_0: There is no significant difference between males and females who studied technology education classes.

H_1: There is a significant difference between males and females who studied technology education classes.

The results indicated that there was no significant difference in gender scores on the standardized technology literacy test between males (N=134, M=14.79, SD=5.55) and females (N=138, M=14.69, SD=5.20) and thus in this case H_0 is retained. Since the study was limited to only this group of students at the eighth-grade level, the reader should not generalize the results but take not that this indeed could help inform the field and stimulate further research along this vein.

The focus of this study was to measure the impact of instruction in technology education to determine if technology education instruction guided by the Standards for Technological Literacy (STL) is enhancing students' technological literacy at the eighth-grade level. The findings are not intended to be generalized to say that all kids who take technology education are technologically literate, yet the results of this study can be a catalyst to others in advancing this science. The focus of the study was to design, construct and test an instrument that would detect differences in student's level of knowledge of technology at the eighth-grade level as defined by STL; the study did advance this knowledge, both statistically, yet more important, methodologically.

Recommendations for Future Research

The researcher makes the following recommendations for further research based on the results and experiences in this study and to further measure the impact of instruction in technology education to determine if technology education instruction guided by the Standards for Technological Literacy (STL) is enhancing students' technological literacy at all grade levels. First, it is important to acknowledge that there were significant limitations to this study in that it was exploratory in nature and was limited to the eighth-grade-level standards and benchmarks. In future studies, expanded assessment should be designed and tested at the middle school level and/or high school. Second, the psychometric instrument must be tested more thoroughly. It is the recommendation from this researcher that item response theory guide further expansion and development of grade level appropriate instruments. It will be a challenge for the field of technology education to measure the depth and breadth of student attainment in each of the content categories and benchmarks because of the challenge of instrument design under classroom and ecological constraints of student testing. Simply put too much content to test in one sitting. Assessment in technology education should look towards a blend of classical testing and authentic assessment that measures not only student knowledge, but also performance. Therefore, if technology educators are going to infer further from this work, we need to expand the scope of the study and to perform more large-scale testing, coupled with more rigorous correlation between instruction and assessment, to determine if in fact the treatment (i.e., technology instruction) is creating the assessed results.

The development of an instrument that measures the level of technological literacy guided by the Standards for Technological Literacy (STL) is needed in order to provide evidence that the Standard for Technological Literacy, when applied properly, can enhance student technological literacy. As mentioned in the addendum to STL *Advancing Excellence in Technology Literacy: Student Assessment, Professional Development, and Program Standards* document (AETL), the instrument should be used as a multi-step process to collect data on how students learn, understand, and the achieve ability to apply what they learn in their daily lives.

The results of this study should not be used as the only instrument to measure technology literacy; on the contrary, it should help the field to understand more clearly what is entailed in developing a psychometric assessment instrument and what additional components need to be addressed to make this instrument more effective. As an additional step, if we can demonstrate that by taking technology education courses, students will perform better in math and science courses, then this will demonstrate the importance of technology education to overall student academic achievement. This indeed should be the next step in enhancing the research advanced by this study.

In addition, the psychometric assessment instrument designed and tested focused on what students should know, not on what students should be able to do, which it is another important area to explore. Technology literacy is not only about being knowledgeable about technology but also about being able to use, manage, and apply technology properly. The use, management, and application of technology open a vast void in current research that must be explored in the future. Specifically, having more open-ended questions, projects, scenario-based, and problem-solving types of questions can help the instrument assess the students' daily learning activities in this technological world. In conclusion, several more assessment instruments must be developed to more accurately and reliably measure technological literacy, furthermore these instruments and assessment protocols must be guided by the principles of the STL and the AETL. In reality, this study served to begin the conversation in the technology education field regarding assessing student attainment in the study of technology as outlined in the content standards and benchmarks for the study of technology (ITEA, 2000).

This research helps to make the case that we can begin to detect gains in technology education students as oppose to those students who have not had a technology education class. However, the test is not yet sensitive enough, and perhaps because of the size and the scope of the standard we may never test with adequate sensitivity. If we are not going to give tests that are comprised of 100 questions, and we are only able to include 35-40 items, then we have to do other types of performance-based assessment methods in addition to this on-demand knowledge test, which will need more discussion and more in-depth research in the area of test and measurement in technology education.

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APPENDIX A: GLOSSARY OF TERMS

Career and Technical Education – Kindergarten through adult programs of study that include rigorous academic content closely aligned with career and technical subject matter, using the state-developed learning standards for career development and occupational studies as a framework. In grades nine through twelve, career and technical education includes the specific disciplines of agriculture education, business and marketing education, family and consumer science education, health occupations education, technical education, technology education, and trade/industrial education (formally known as Vocational Education) (100.1 Definitions, retrieved February 8, 2006, from http://www.emsc.nysed.gov/part100/pages/1001.html#career%20and%20technical%20education).

Educational Technology – Using multimedia technologies or audiovisual aids as a tool to enhance the teaching and learning process (International Technology Education Association, 2000).

Industrial Arts – Those occupations in which changes are made to materials to increase their values for human usage. As a subject for educational purposes, industrial arts is a study of the changes made by humans to materials to increase their values, and of the problems of life related to those changes (Olson, 1963).

Industrial Education – A field of study designed to prepare technical and/or management-oriented professionals for employment in business, industry, education, and government. Industrial Technology is primarily involved with the management, operation, and maintenance of complex technological systems while engineering and engineering technology are primarily involved with the design and installation of these systems (National Association of Industrial Technology, retrieved February 8, 2006, from http://www.nait.org/).

Industrial and Technology Education – A kindergarten-through-university career pathway of well-planned experiences. These experiences prepare students for successful transition to the workforce (Industrial and Technology Education: Career Path Guide and Model Curriculum Standards, 1996. p. iv)

Science Literacy – Knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity. It also includes specific types of abilities. In the *National Science Education Standards*, the content standards define scientific literacy. (National Research Council, 1996).

School-to-Career – Provides students with the necessary academic and vocational-technical education to transition from secondary education to high-quality employment and further education (California Department of Education, 2006, April 4).

Technology – Application of knowledge and the use of resources to meet human needs and solve problems. (International Technology Education Association, retrieved February 8, 2006, from http://www.iteaconnect.org/index.html).

Technology Education – Technology education is a school subject that teaches students in grades K- 12 how to be technologically literate. In technology education, learning is brought to life through concrete, hands-on learning experiences in laboratory environments. Through drawing, planning, designing, problem solving, building, and testing, students become involved in critical and creative thinking and creative activities. Students explore, ask questions, use resources of information, and learn to construct solutions that lead to more questions and additional solutions. They also learn that there is no perfect design that meets all the criteria and constraints, and therefore, the best design must balance tradeoffs (California Department of Education, 2005, May 20).

Technology Literacy – Includes the possession of computer skills and the ability to use computers and other technology to improve learning, productivity, and performance. A goal related to technology literacy is to ensure that all students and teachers have equitable access to and can make effective use of technology (North Central Regional Educational Laboratory, retrieved February 8, 2006, from http://www.ncrel.org/sdrs/areas/issues/methods/ technlgy/te4lk7.htm).

Technological Literacy – Technological literacy involves the ability to use, manage, and understand the myriad of technology surrounding us. The technologically literate person has knowledge and understanding of our technological surroundings (International Technology Education Association, 2000).

Tech Prep – Designed to implement programmatic connections between high schools and two-year colleges encompassing specific technical fields and occupational areas (California Department of Education, 2006, March 23).

APPENDIX B: CONSENT FORMS AND CORRESPONDENCE

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
Fort Collins, CO [illegible]
[illegible]
FAX [illegible]

Notice of Approval for Human Research

Principal Investigator: Michael DeMiranda, Education 1588
Co-Principal Investigator: Mauricio Castillo, Education 1588
Title: Measuring Technology Literacy: The Design and Testing of an Assessment Instrument to Measure Eighth-Grade Achievement in the Study of Technology.
Protocol #: 06-145H **Funding Source:** N/A
Number approved: 400 12-14 year olds
Committee Action: **Approved on:** August 21, 2006 **Expires:** June 22, 2007
HRC Administrator: Janell Meldrem [illegible]

Consent Process:
The above-referenced project was approved by the Human Research Committee with the condition that the attached consent form is signed by the subjects and each subject is given a copy of the form. *NO changes may be made to this document without first obtaining the approval of the Committee.* Subjects under the age of 18 years old must obtain parental permission and give their assent to participate.

Conditions:
The signed letters of cooperation from the participating schools and teachers must be obtained and submitted to the HRC prior to recruitment.

Investigator Responsibilities:

- It is the PI's responsibility to obtain consent from all subjects.
- It is the responsibility of the PI to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research.
- It is also the PI's responsibility to notify the Committee of any changes in experimental design, participant population, consent procedures or documents. This can be done with a memo describing the changes and submitting any altered documents.
- Students serving as Co-Principal Investigators must obtain PI approval for any changes prior to submitting the proposed changes to the HRC for review and approval.
- The PI is ultimately responsible for the conduct of the project.
- A status report of this project will be required within a 12-month period from the date of review. Renewal is the PI's responsibility, but as a courtesy, a reminder will be sent approximately two months before the protocol expires. The PI will be asked to report on the numbers of subjects who have participated this year and project-to-date, problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary continuation form (H-101) is available from the RCO web page www.research.colostate.edu/rco/welfare/.
- Upon completion of the project, an H-101 should be submitted as a close-out report.
- If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice.
- **Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.**

Please direct any questions about the Committee's action on this project to me for routing to the Committee.

Attachment Date of Correspondence: 8/2x/06

[illegible]
[illegible] · www.research.colostate.edu/[illegible]

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: Measuring Technology Literacy: The Design and Testing of an Assessment Instrument to Measure Eighth-grade Achievement in the Study of Technology.

PRINCIPAL INVESTIGATOR: Michael A. De Miranda, mdemira@cahs.colostate.edu, 970.491.5805
104A Education Building
Fort Collins, CO 80523

CO-PRINCIPAL INVESTIGATOR: Mauricio Castillo, mcastill@cahs.colostate.edu, 323.864.3290
104A Education Building
Fort Collins, CO 80523

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? I am asking your child to participate in this study because he/she is an eighth-grade middle school student who may be or may not be taking a technology education class. The score in your technological literacy test of your child will allow me assess how technological literate you are after taking a technology education class at your school.

WHO IS DOING THE STUDY? The study is being conducted by Mauricio Castillo, a Ph.D. Candidate at Colorado State University.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of this research is to design and test an assessment instrument to measure eighth-grade achievement in the study of technology grounded in the standards for technological literacy.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? The study will be take place at your child middle schools. The test will take about 30-45 minutes in one day at the beginning of the eighth-grade level.

WHAT WILL I BE ASKED TO DO? Your child will be asking to take a technological literacy test in a technology education class or other class. The test should not affect his/her grade in their classes and it should take about 30-45 minutes (one class period) to complete the tests.

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY?
If you or your children are not comfortable for you to take the technological literacy test or additional school-related scores information you may not want to participate in this study. This study is limit to eighth-grade students.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?
Your child will not be requiring to submitting their name in the test. You child be assigned a numerical number that only the researcher will know the meaning of that number. It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

WILL I BENEFIT FROM TAKING PART IN THIS STUDY? There are no known benefits to participating in this study, but I hope you will gain more personal knowledge about how technological literate your child is.

DO I HAVE TO TAKE PART IN THE STUDY? The participation of your child in this research is voluntary. If you or child decides to participate in the study, you or your child may withdraw your consent and stop participating at anytime without penalty or loss of benefits to which you are otherwise entitled.

WHAT WILL IT COST ME TO PARTICIPATE? No cost to participate.

WHO WILL SEE THE INFORMATION THAT I GIVE?
I will keep private all research records that identify your child, to the extent allowed by law. At the time of the test, the test will have a number or fake name (your children do not need to put your real name). For example, the name of your child will be kept separate from your research records and these two things will be stored in different places under lock and key. I will make any effort to prevent anyone who is not on the research team from knowing that your children gave us information, or what that information is. Your child information will be combined with information from other people taking part in the study. When I write about the study to share it with other researchers, I will write about the combined information I have gathered. Your child will not be identified in these written materials. I may publish the results of this study; however, I will keep your child name and other identifying information private.

CAN MY TAKING PART IN THE STUDY END EARLY? Your child may be asking to leave this study if you are unwilling or if he/she is unable to take the test during the research time.

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY? No compensation will be given to you or your child for taking part in this study.

WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

WHAT IF I HAVE QUESTIONS?
Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the co-investigator, Mauricio Castillo at 323-864-3290. If you have any questions about your rights as a volunteer in this research, contact Janell Meldrem, Human Research Administrator at 970-491-1655. I will give you a copy of this consent form to take with you.

WHAT ELSE DO I NEED TO KNOW?
Your and your children signatures acknowledge that you have read the information stated and willingly sign this consent form. Your and children signatures acknowledges that you and your parents/guardians have received, on the date signed, a copy of this document containing 2 pages.

_______________________________________ ____________________
Signature of person agreeing to take part in the study Date

____
Printed name of person agreeing to take part in the study

_______________________________________ ____________________
Name of person providing information to participant Date

____
Signature of Research Staff

Page 2 of 3 Participant's initials ______ Date ______

PARENTAL SIGNATURE FOR MINOR

As parent or guardian, I authorize ________________________ (print name) to become a participant for the described research. The nature and general purpose of the project have been satisfactorily explained to me by **Mauricio Castillo** and I am satisfied that proper precautions will be observed.

____
Minor's date of birth

____
Parent/Guardian name (printed)

_________________________________ ____________________
Parent/Guardian signature Date

Page 3 of 3 Participant's initials _______ Date _______

Mauricio Castillo
6534 E. Hereford Drive
Los Angeles, CA 90022

September 8, 2006

XXXXXXX Middle School
12345 XXXXXXX St.
Los Angeles, CA 90XXX

Dear student:

I'm a student at Colorado State University. I'm working to better understand how students like you learn about technology. This is called research. My research is about measuring what you have learned in your exploring technology education class. I would like you to be part of my research and take a short test related to technology.

If you agree, then I will ask you to tell me if you took a technology class before eighth grade or not. Then if you did not take a technology class, you will complete a 30 questions test. The test is a multiple-choice test. It will take about 30 to 45 minutes. Your name will not be on the test, so no one will know how you answered any of the questions or what score you received.

Agreeing to be part of this project cannot hurt you; it will not help you either. You will not get any gift for doing it. You do not have to do it. If you say "yes" now but later change your mind, you can stop being in the research any time by just telling me.

In addition, I will ask your parents if it is okay for you to participate in this, too. If you want to be in this research, sign your name and write today's data on the line below. Thank you very much and I look forward to working with you.

______ **Yes,** I have taken a technology class.

______ **No**, I **haven't** taken a technology class.

____ ____________

Print Student Name Date

____ ____________

Mauricio Castillo, Researcher Date

Date

Dear Mr/Ms XXXXXXXX, Principal

My name is Mauricio Castillo. I am a Ph.D. student working with Dr. Michael A. De Miranda at Colorado State University. I am conducting a research study to measure technological literacy achievement in eighth-grade students. I am seeking your permission to allow three general education teachers and their students to participate. No student names will be required and all information will be confidential. The protocol for this study has been approved by the Human Research Committee at Colorado State University. This approval helps assure that all schools, teachers, and students who participate in this study are protected. In addition, we will also seek parent and individual student permission for each who participates.

The target population for this study is eighth-grade students that are completing or have completed a technology education course. I have selected your school as one of the sites for this study because it doesn't offer a technology education program. For data gathering purposes, this research will employ a self made test. I will need to recruit a class or classes with student taking a technology education class and the same amount of student not taking at technology class who meet the selection criteria. The entire test administration process should take no more than 30-45 minutes.

If you agree to allow me to conduct this research in your school, I will need a letter of cooperation from you granting approval. In the letter you should state that you are familiar with the project, that you are satisfied that the individuals involved are adequately protected as human research subjects, that you are aware that your students and teachers participation is completely voluntary, and you understand what your school involvement will entail. Please send this letter to: Mauricio Castillo c/o

Michael A. De Miranda
School of Education
Colorado State University
Fort Collins, CO 80523

Should you have any questions regarding the approval letter or your schools participation, please contact me at my email address below. You may also want to contact my advisor, Dr. Michael A. De Miranda at (970)491-5805 or mdemira@cahs.colostate.edu .

Sincerely,

Mauricio Castillo
mcastill@cahs.colostate.edu

September 8, 2006

Mauricio Castillo
6534 E. Hereford Drive
Los Angeles, CA 90022

September 8, 2006

XXXXXXX Middle School
1234 XXXXXXX St.
Los Angeles, CA 90XXX

Dear ___________________:

My name is Mauricio Castillo. I am a Ph.D. student working with Dr. Michael A. De Miranda at Colorado State University. I am conducting a research study to measure technological literacy achievement in eighth-grade students. Your principal, XXXXXXXX, has granted me permission to ask if we could use your classes in this study. Your class participation is strictly voluntary. No student or teacher names will be required and all information will be confidential. The protocol for this study has been approved by the Human Research Committee at Colorado State University. This approval helps assure that all schools, teachers, and students who participate in this study are protected. In addition, we will also seek parent and individual student permission for each who participates.

The target population for this study is eighth-grade students that are completing or have completed a technology education course. I have selected your school as one of the sites for this study because it has a strong technology education program. For data gathering purposes, this research will employ a self made test. The entire test administration process should take no more than 30-45 minutes.

If you agree to allow me to conduct this research in your classroom, I will need a letter or email indicating that you agree to allow this study to be conducted in your classroom and that you are aware that your participation is completely voluntary. Please send this letter to: Mauricio Castillo c/o, Michael A. De Miranda, School of Education, Colorado State University, Fort Collins, CO 80523.

Finally, if you have any questions regarding your participation, please contact me at my email address for further information at mcastill@cahs.colostate.edu. You may also want to contact my advisor, Dr. Michael A. De Miranda at (970)491-5805 or email him at mdemira@cahs.colostate.edu .

Sincerely,

Mauricio Castillo

Mr/Ms. XXXXXXX
Principal
XXXXXXX Middle School
12345 XXXXXXX St.
Los Angeles, CA 90XXX

October 1, 2006

Mauricio Castillo c/o
Michael A. De Miranda
School of Education
Colorado State University
Fort Collins, CO 80523

Dear Mauricio Castillo

I, XXXXXXXX, principal at XXXXXXX Middle school agree to cooperate and allow Mauricio Castillo to conduct his research in my school. I'm familiar with his project, and I'm satisfied that the individuals involved are adequately protected as human research subjects, aware that students and teachers participation is completely voluntary, and understand what my school involvement will entail.

Sincerely,

XXXXXXXXXXX

Mr/Ms. XXXXXXXXX
XXXXXXX Middle School
12345 XXXXXXXX St.
Los Angeles, CA 90XXX

September 11, 2006

Mauricio Castillo c/o
Michael A. De Miranda
School of Education
Colorado State University
Fort Collins, CO 80523

Dear Mauricio Castillo

I, XXXXXXXX teacher at XXXXXXX Middle school agree to cooperate and allow Mauricio Castillo to conduct his research in my classroom. I'm familiar with his project, and I'm satisfied that the individuals involved are adequately protected as human research subjects, aware that students and teachers participation is completely voluntary, and understand what my school involvement will entail.

Sincerely,

XXXXXXXXXX

Dr. XXXXXXX,

My name is Mauricio Castillo. I am a Ph.D. student currently in the Ph. D. dissertation stage working with Dr. Michael A. De Miranda at Colorado State University. A portion of my study requires the design and testing of an assessment instrument to measure technological literacy in light of the standards for technological literacy, at the grade level 6-8 benchmarks. As part of this research, content validity of the test bank items is very important. As a recognize expert in the field of technology education I am asking you if will be interested in participating as a content expert. If you would accept, I would like to request a valid mail address where you will like the materials to be sent. Should you agree, I will be send evaluation materials within the next week. Your expertise will be use to help improve the validity of the content test items. Should you have any questions, please feel free to call me at (970)420-6002 cell or email me at mcastill@cahs.colostate.edu I will be delighted to discuss this with you. I appreciated your help in moving this part of research for technology education forward.

Sincerely,

Mauricio Castillo

September 7, 2006

RE: Content Validity Review

Dear Dr. XXXXXX,

I would like to take this opportunity to thank you for agreeing to serve as a content expert reviewer for my technology literacy assessment instrument. A portion of my study requires the design and testing of an assessment instrument to measure technological literacy in light of the Standards for Technological Literacy for grades 6-8 benchmarks. As part of this research, content validity of the test bank items is very important. Due to the length of the master item test bank and respect for your professional time, I'm asking you to review only a portion of the test bank items. Therefore, the form A and form B items you review may only address several standard benchmarks.

Your task is to review each item in light of alignment with the Standards for Technological Literacy and grade 6-8 benchmarks. For each question, please provide feedback on the following:

- Clarity and readability of each item
- Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
- Item difficulty
- Any other comments and suggestions you may have that would increase the content validity of the item.

Your input will be used to help improve the validity of the test item content. Please feel free to make any comments or corrections that you think are appropriate. Please return your response by September 25th, 2006 in the enclosed self addressed stamped envelope. Your participation is greatly appreciated. Should you have any comments or concern, please call me at (970) 420-6002 or email me mcastill@cahs.colostate.edu . I appreciate your help in moving this part of research for technology education forward.

Thank you for your cooperation in this study.

Sincerely,

Mauricio Castillo

Mauricio Castillo

Michael A. De Miranda, Ph.D.

The Nature of Technology

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

1. A machine called Rapid Prototyping can turn drawings into
a. CAD drawings b. modeling software
c. three dimensional objects d. laser

1a. _______________ enables people to improve current technologies or solve problems.
a. Music b. English
c. Technology d. Math
1F

G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative.

2. When you hear "You don't want to reinvent the wheel," they mean
a. do the same work again
b. look for a shorter way of improve
c. don't do the same work as others have already done.
d. think how technologically you can improve

2a. People create this to _________________ meet human needs and wants.
a. Engineering b. Math
c. Technology d. Science
1G

H. Technology is closely linked to creativity, which has resulted in innovation.

3. The modification of an existing product or system is called
a. innovation b. new technology
c. manufacturing d. process

3a. An invention can always be ___________.
a. modeled b. **improved**
c. replaced d. misplaced
1H

I. Corporations can often create demand for a product by bringing it onto the market and advertising it.

4. When you conduct a survey to find out how well a product is going to sell is called
a. quality control
b. market research
c. scientific management
d. production

4a. When you see a commercial on TV, they are ________.
a. Promoting the product
b. testing the product
c. checking for quality of the product
d. none of the above
1I

Standard 2: Students will develop an understanding of the core concepts of technology.

M. Technological systems include input, processes, output, and at times, feedback.

5. The fuel level indicator on your car is an example of ______________.
a. not paying attention
b. a feedback system
c. an empty tank
d. a display indicator

5a. When a system cannot measure or control its output is called
a. process
b. open-loop system
c. normal flow
d. closed-loop system

5b. The end result on a product is called
a. design
b. flow
c. output
d. system
2M

N. Systems thinking involves considering how every part relates to others.

6. The purpose of a transistor in a radio is to
a. control speed
b. measure current
c. control electric current
d. control the component

6a. Your computer, monitor, keyboard, and speakers are an example of parts of a _ ______.
a. group
b. system
c. motor
d. team
2N

O. An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback.

7. The sound or alarm of a smoke detector is a type of __________ communication.
a. people to people
b. machine to machine
c. machine to people
d. people to machine

7a. When a system requires human intervention it is called _______.
a. an open-loop
b. a system
c. a feedback
d. a close-loop
2O

P. Technological systems can be connected to one another.

8. Which device does not control other devices?
a. speakers
b. light switch
c. garage opener
d. remote control

8a. You can connect your VCR to what other component?
a. microwave
b. Television
c. refrigerator
d. printer
2P

Q. Malfunctions of any part of a system may affect the function and quality of the system.

9. Which statement is true about a malfunctioning system?
a. it can be prevented
b. can affect our environment
c. it can be replaced
d. a and b

9a. Name two things that may happen if something malfunction's in a product
a. May affect the function and quality of the product
b. May need to replace it and spend money
c. May need to contact the store and the company
d. May affect the function and may need to replace it.

2Q

R. Requirements are the parameters placed on the development of a product or system.

10. When you design a new bicycle, you should establish the following?
a. price, quality, and quantity
b. quality versus quantity
c. criteria and constraints
d. a and c

10a. A restriction or requirement identified during the design phase of a product is called
a. run of time
b. a problem arises
c. a constraint
d. design problem
2R

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

11. From the list below, which is the best trade-off for the International Space Station to recharge its battery?
a. using the sun
b. taking extra batteries in the cargo
c. nuclear energy
d. using gas engines

11a. When you choose something instead of another is an example of __________.
a. a want
b. a solution
c. a need
d. a trade-off
2S

T. Different technologies involve different sets of processes.

12. Method of printing using open screen of silk, nylon, or metal mesh is _______ ______.
a. ink-jet printing
b. flexography
c. gravure printing
d. serigraphy

12a. The two types of processes used in technological systems are _____________.
a. Managing and producing
b. output and inputs
c. planning and organizing
d. directing and controlling
2T

U. Maintenance is the process of inspecting and servicing a product or system on a regular basis in order for it to continue functioning properly, to extend its life, or to upgrade its quality.

13. When building a new school which requirements may not be required to be in a city's building code?
a. fire extinguishers
b. exit signs
c. amount of chairs
d. parking space

13a. The reason you should service and maintain your car is because ___________.
a. You want your car to last longer
b. you want to impress your friends
c. You don't want any future problems
d. you want to have a nice car
2U

V. Controls are mechanisms or particular steps that people perform using information about the system that causes systems to change

14. A process that uses commands from a computer to control a machine is called
a. computer-aid manufacturing (CAM) **b. Computerized Numerical Control (CNC)**
c. computer-integrated manufacturing (CIM) d. Just in Time (JIT)

14a. Inside this device is a microprocessor that allows your TV to change channels
a. You remote control b. your brain
c. your car keys d. the door bell
2V

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

D. Technological systems often interact with one another.

15. Systems used to accurately establish a receiver's position is a _____________.
a. compass **b. global position system (GPS)**
c. map d. globe

15a. Your computer comes with software and programs for you to have better
a. programming b. system
c. interaction d. connection
3D

E. A product, system, or environment developed for one setting may be applied to another setting.

16. The compact disc is an evolution of the
a. telegraph b. printer
c. television set **d. Edison's cylindrical record**

16a. This device has many operations such as a CD player, DVD player, and recorder.
a. Television b. CD/DVD player
c. video camera **d. computer**
3E

F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

17. Recycled cooking oil can be use in this method of transportation
a. solar-generated electric car b. train
c. grease car d. airplane

17a. In technology, you can use the knowledge gained from other field to improve others.
a. **Always** b. Sometimes
c. Never d. I don't know
3F

Technology and Society

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use.

18. Science explains how things work and while _________ makes things happen
a. Technology b. History
c. Engineering d. Mathematics'

18a. What of the following things can affects humans when using technology ____.
a. safety b. comfort
c. choices **d. flexibility**
4D

E. Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.

19. A negative affect that Communication technology creates on our environment is
a. the use of more computers **b. the use of more paper**
c. the use of more plastics d. the use of more water

19a. The following are samples of negative impacts of technology except _______.
a. air pollution b. soil erosion
c. recycling d. water pollution
4E

F. The development and use of technology poses ethical issues.

20. Technology is defined as
a. computers in the classroom b. electronic equipment that help human achieve a goal.
c. things that we use every day **d. practical use of knowledge to satisfy human wants and needs.**

20a. One of the problems that technology faces everyday is that _________.
a. **Its not available for everyone** b. Its free
c. its expensive d. Its not improving the world
4F

G. Economic, political, and cultural issues are influenced by the development and use of technology.

21. In today's society, people who work with technology are
a. Scientists b. Mechanics
c. Technicians d. Artisans

21a. The development of technology influence the following except ___________.
a. economics **b. demographics**
c. political d. cultural issues
4G

Standard 5: Students will develop an understanding of the effects of technology on the environment.

D. The management of waste produced by technological systems is an important societal issue.

22. To recycle means
a. to reduce pollution **b. to use again**
c. to carpool d. to send waste to landfills

22a. The following materials has decreased the waste into the landfills except ____.
a. glass b. paper
c. aluminum **d. oil products**
5D

E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems.

23. Which scenario is an example of biosynthesis?
a. using bacteria to clean to contaminated land
b. making chemicals using biological processes
c. using genetically modified organism to produce medicine
d. a human made, controlled environment

23a. How technologies can be used to repair damage caused by nature disasters?
a. by finding new ways of reducing waste production
b. by conserving more energy
c. by reducing the use of nonrenewable resources
d. all of the above
5E

F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.

24. Which is an advantage of a fuel cell?
a. they are cheap
b. they are practical
c. they don't pollute
d. they are easy to find

24a. When decisions to develop and use technologies are made. What type of damages can occur to the environment?
a. water pollution
b. soil erosion
c. noise pollution
d. all of the above
5F

Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.

25. A method that is used to help crops get the right amount of water is called ____.
a. fertilization
b. Irrigation
c. Monoculture farming
d. hybrid

25a. The invention and innovation of computing has resulted from _______ demands.
a. information
b. business
c. individual
d. all of the above
6D

E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants.

26. The Information Age is best known for
a. iron replaced metals
b. rebirth on the arts and humanities
c. manufacturing, transportation, communication, and construction
d. invention, process, storage, and exchange of data

26a. Innovation can make inventions ____________.
a. work better
b. be less expensive
c. be built with better materials
d. all of the above
6E

F. Social and cultural priorities and values are reflected in technological devices.

27. What is the name of the new transportation concept that uses both gasoline engine and electric motor

a. hybrid car b. solar car
c. locomotives d. airplanes

27a. Technology has changed the social and cultural ways people communicate through the use of this device

a. cellular telephone b. printed text
c. microwave d. none of the above

6F

G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

28. In what ways can graphic communications harm our environment?

a. by using computer b. by using film
c. by using printing plates **d. by using chemicals and printing inks**

28a. When selecting a cellular phone, people often want the following:

a. to be small b. easy to use
c. inexpensive **d. all of the above**

6G

Standard 7: Students will develop an understanding of the influence of technology on history.

C. Many inventions and innovations have evolved using slow and methodical processes of tests and refinements.

29. Start and build their work based on the earlier work and discoveries of others

a. Engineers b. Scientists
c. Technicians **d. All of the above**

29a. One early inventor that created plans and drawings for bicycles, helicopters, gears, and parachutes is

a. Albert Einstein b. Isaac Newton
c. Leonardo da Vinci d. Robert Goodyear

7C

D. The specialization of function has been at the heart of many technological improvements.

30. What is the purpose of a memory card in a digital camera?
a. takes the picture
b. store images or pictures
c. charges the camera
d. prints the image

30a. The improvement of technological devices took in some instances years because
a. no materials were available
b. of designs
c. ideas took longer to create
d. lack of inventions
7D

E. The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships.

31. A home heating and air conditioning thermostat controls
a. repair of your heater
b. money saving
c. downloaded music
d. indoor air temperature

31a. A ruler is effective in measuring the following except:
a. length
b. thickness
c. temperature
d. width
7E

F. In the past, an invention or innovation was not usually developed with the knowledge of science.

32. The profession that involves designing products or structures
a. Engineers
b. Scientists
c. Mechanics
d. Doctors

21a. Early inventions or innovations were not usually developed with the knowledge of
a. Mathematics
b. Science
c. Engineering
d. Technology
7F

Design

Standard 8: Students will develop an understanding of the attributes of design.

E. Design is a creative planning process that leads to useful products and systems.

33. When you use the computer and printer to produce a flyer or magazine is called
a. printing
b. reporter
c. desktop publishing
d. graphic design

33a. When creating a new product, you should do this first.

a. draw it
b. sketch it
c. design it
d. produce it

8E

F. There is no perfect design.

34. The process that follows identifying a problem is called

a. Research and Design
b. Brainstorming
c. Establishing criteria
d. Thinking

34a. A prototype is ______________.

a. a picture
b. the first working design
c. a sketch
d. a model

8F

G. Requirements for design are made up of criteria and constraints.

35. Which department is in charge of the research and development of new ideas

a. Business department
b. Quality and Control department
c. Help desk development
d. Research and Development department

35a. In the first step of the design process what items should be identified first.

a. the desired needs and wants
b. the designs and the needs
c. the problems and wants
d. the solutions and the problems

8G

Standard 9: Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

36. One of the first steps in the problem solving process is

a. Criteria
b. evaluation the solution
c. brainstorming
d. Define problem

36a. Each design problem is unique and may require

a. different procedures
b. steps in different sequences
c. team effort
d. a, b and c

9F

G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.

37. The technique that helps you to solve a problem rapidly is called

a. Criteria	b. evaluation the solution
c. constraints	**d. brainstorming**

37a. When a group is asked to give or provide as many solutions as possible in a short time is called

a. Criteria	b. evaluation the solution
c. constraints	**d. brainstorming**

9G

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

38. A method that changes the shape of a material is called ______.

a. finishing	**b. forming**
c. conditioning	d. combining

38a. It's used to communicate ideas in a three-dimensional copy of a new product.

a. drawing	b. two dimensional drawing
c. a model	d. sketches

9H

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.

39. Before a new product is sent to production, it should be____________.

a. evaluated the solution and market the product	**b. prototyped and tested**
c. market the product and test it	d. define the problem and create a prototype

39a. The name of the procedure used to identify the cause of the malfunction in a technological system is:

a. trouble shooting	b. collect information
c. experiment	d. process

10F

G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.

40. An invention is turning ideas and imagination into a new device, while an innovation is

a. turning ideas turns into a creation
b. the design of equipment
c. being repaired to make it work
d. modify existing product or system

40a. The evolution of the bicycle to motorcycle is an example of

a. an invention
b. an idea
c. an innovation
d. a discover

10G

H. Some technological problems are best solved through experimentation.

41. An _____________ is a controlled way to discover new knowledge

a. theory
b. trial and error
c. experiment
d. defining the problem

41a. In technology, the method used to solve some technological problems is through experimentations, which other method is similar to experimentation

a. hypothesis method
b. scientific method
c. theory method
d. testing method

10H

Abilities for a Technological World

Standard 11: Students will develop abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

42. Plastic that can be heated and shaped one time only are called

a. thermosetting plastics
b. inorganic materials
c. organic materials
d. Metals

42a. When using the engineering design process __________ uses math skills to help us understand how the design may function.

a. the prototype
b. building the part
c. trial and error
d. mathematical modeling and analysis

11H

I. Specify criteria and constraints for the design.

43. One of the most popular building materials used in the U.S. is
a. metal
b. wood
c. ceramics
d. composites

43a. Constraints are the limitations for the design while the criteria are
a. a clear definition of the problem
b. problems dealing with society
c. elements of the problem needing to be solved
d. problems that can affect individuals
11I

J. Make two-dimensional and three-dimensional representations of the designed solution.

44. A program that can create virtual models using visual software is called
a. computerized numerical control program (CNC)
b. computer-aided drafting program (CAD)
c. Photoshop
d. SPSS program

44a. Examples of two-dimensional and three dimensional forms are:
a. sketches
b. drawings
c. computer-assisted designs
d. all of the above
11J

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

45. The advantages of a rapid prototype machine
a. the product is made of metal
b. is the final replica of the product
c. is more expense than casting
d. it creates a prototype or model in a few minutes

45a. One of the many sources a designer receives information on how to improve the design is through:
a. customer's
b. government agencies
c. competitors
d. all of the above
11K

L. Make a product or system and document the solution.

46. The software you can use to present text, graphics, and other media is called
a. writing software
b. computer-aided design software (CAD)
c. presentation software
d. drawing software

46a. When making a product you should use all of these methods to document the solution.

a. camera
b. design portfolios
c. journals
d. all of the above

11L

Standard 12: Students will develop abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

47. Whenever you have a problem with an appliance at your home, you should first refer to

a. the library
b. the help desk
c. the appliance manual
d. the teacher

47a. When installing a new computer, you should use the following item

a. almanac
b. your computer manual
c. your TV manual
d. your instincts

12H

I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems.

48. Most automotive repair shops use this to diagnose a problem in a cars computer control system.

a. books
b. manuals
c. computer scanner
d. technician

48a. When installing or repairing electronic equipment the most important thing to follow are

a. the recommended instructions
b. the manual
c. the road
d. the safety procedures

12I

J. Use computers and calculators in various applications.

49. The microwave oven is an example of

a. an analog device
b. a digital device
c. transmitter
d. laser

49a. Most new cars use this device to control and service the car

a. computers
b. technicians
c. tools
d. manuals

12J

K. Operate and maintain systems in order to achieve a given purpose.

50. Electronic signals can be sent through the following except
a. wire
b. electromagnetic waves
c. optic cables
d. wood

50a. Some of the skills a technician should have to repair equipment should be
a. understand the operation and maintenance
b. correct the problem
c. read the manual
d. none of the above
12K

Standard 13: Students will develop abilities to assess the impact of products and systems.

F. Design and use instruments to gather data.

51. The best way to test a solution is by
a. trial and error
b. put the solution to work
c. market the product
d. define the problem

51a. When a weather satellite collects raw facts and figures for a report, it is called
a. scientific method
b. research process
c. **Data**
d. conclusion
13F

G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology.

52. To be able to use and understand technology is to be
a. a scientist
b. technological literate
c. an engineer
d. smart

52a. Data collected from buildings during a hurricane can help builders
a. collect data
b. conduct surveys
c. build models
d. design new material and building techniques
13G

H. Identify trends and monitor potential consequences of technological development.

53. This method helps identify the cause of a malfunction
a. troubleshooting
b. prototype and test it
c. engineering
d. constraints

53a. A trend in communication, especially in cellular phones and consumers is phones
a. need to be built bigger
b. do not need a camera
c. need to be one color only
d. need to be smaller and lighter
13H

I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful.

54. What method should you use to decide which product is better that the other?
a. collect more information
b. test them
c. read about it
d. an evaluation experiment

54a. Engineers do this to existing products and systems to determine if they useful or not.
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent
13I

The Designed World

Standard 14: Students will develop an understanding of and be able to select and use medical technologies.

G. Advances and innovations in medical technologies are used to improve healthcare.

55. A heart monitoring machine is an electronic device that changes one form of energy to another; from sound to
a. water
b. laser
c. an electric signal
d. air

55a. By using technology, health care professional help people _________.
a. with side affects
b. with their problems
c. live better lives
c. live longer

55b. In the field of health and medicine, technology helps to ________________________.
a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above
14G

H. Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety.

56. A method that achieves very clean tools and equipment in the hospital?
a. Pasteurization
b. sterilization
c. irradiation
d. sanitation

56a. Sanitation processes used in the disposal of medical products help control

_________.

a. people
b. treatment
c. disease
d. medicine
14H

I. The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccines is produced.

57. Is a vaccination that makes the body resist to disease
a. immunization
b. vaccine
c. food additives
d. smallpox

57a. Vaccines are special drugs created to prevent diseases from affecting
a. computers
b. equipment
c. people
d. none of the above
14I

J. Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups.

58. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

58a. Genetic engineering is done __________.
a. at home
b. at a school
c. in a laboratory
d. at an unsafe place
14J

Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

F. Technological advances in agriculture directly affect the time and number of people required to produce food for a large population.

59. Is a chemical that restores nutrients to the soil?
a. irrigation
b. monoculture
c. fertilizer
d. hydrid

59a. Technological advances allow people to grow food _______________.
a. in bigger machines
b. in better fields
c. in shorter periods of time
d. in more time
15F

G. A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals.

60. A method use by farmers to water their crops is
a. bioremediation
b. irrigation technology
c. dehydrated
d. monoculture

60a. Biotechnology deals with using biology principles and processes to
a. harm the crops
b. produce commercial goods or services
c. create diseases
d. none of the above
15G

H. Biotechnology applies the principles of biology to create commercial products or processes.

61. The biology of plant growth in agriculture comes from this area of science
a. plant science
b. chemical science
c. technology
d. physical science

61a. Bioconversion is a type of ________________.
a. biotechnology
b. manufacturing technology
c. transportation technology
d. construction technology
15H

I. Artificial ecosystems are human-made complexes that replicate some aspects of the natural environment.

62. Re-circulates water and fertilizer to grow plants
a. hydroponics
b. aquaculture
c. agroforestry
d. biotechnology

62a. ______________ are human-made systems reproducing some parts of the natural environment.
a. dehydration
b. canning
c. artificial ecosystems
d. chemical preservation
15I

J. The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food.

63. An example of dehydrated food is
a. apples
b. pizza
c. cheese
d. cookies

63a. Preserving food by removing its moisture is called _________.

a. dehydration b. canning
c. artificial ecosystems d. chemical preservation
15J

Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.

E. Energy is the capacity to do work.

64. Some forms of energy are
a. mechanical energy b. electrical energy
c. chemical energy **d. All of the above**

64a. When force is used to move an object, this is produced _________.
a. energy b. power
c. heat energy **d. work**
16E

F. Energy can be used to do work, using many processes.

65. Gasoline, diesel, and rocket engines are sample of
a. solar powered motor b. external combustion engines
c. internal combustion engines d. battery powered motor

65a. It can be used to powers our cars, trains, and planes and lights our homes, stores, and offices.
a. work b. muscle
c. energy d. power
16F

G. Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done.

66. What measurement is use to determine how quickly the work is done?
a. horsepower b. distance
c. power **d. rate**

66a. Is a measure that is generally expressed in wattage or horsepower?
a. distance b. energy
c. volume **d. power**
16G

H. Power systems are used to drive and provide propulsion to other technological products and systems.

67. By collecting solar energy, solar panels can generate

a. electricity b. solar energy

c. nuclear energy d. mechanical energy

67a. Chances wind energy into electrical energy

a. wind generator b. power system

c. engine d. battery

16H

I. Much of the energy used in our environment is not used efficiently.

68. Which of the following is not a way to conserve more energy?

a. carpooling b. insulation

c. turn off lights **d. leaving the lights on**

68a. The act of making better use of energy is called ___________.

a. polluting b. recycling

c. technology **d. conservation**

16I

Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

H. Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human.

69. The communication mode used when you play a video game is

a. people to machine b. machine to people

c. machine to machine d. people to people

69a. Talking to your friends at school is an example of _______________ communication.

a. people to people b. machine to people

c. machine to machine d. people to machine

17H

I. Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination.

70. The radio in your car is a __________ and the radio station is the _________.

a. message, messenger **b. receiver, transmitter**

c. cd player, cd d. encoder, decoder

70a. Which of the following devices change a signal from an analog to digital

a. video camera
b. motherboard
c. hardrive
d. keys on the keyboard

17I

J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

71. The code in which information on the World Wide Web is written

a. URL
b. browser
c. search engine
d. HTML

71a. The following technologies help handicapped people communicate except

a. audiotapes
b. internet
c. closed-captured television
d. hand signals

17J

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

72. The technique used to make drawing that describe the exact size, shape, and structure of objects is called

a. drafting
b. sketching
c. painting
d. drawing

72a. The way we communicate ideas in a technological system is by

a. speaking and writing
b. drawing, photos and symbols
c. by looking in the mirror
d. a and b

17K

Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.

F. Transporting people and goods involves a combination of individuals and vehicles.

73. The space shuttle is a ______________________ transportation vehicle.

a. land and water
b. land and space
c. air and space
d. air and land

73a. Transporting people and goods involves a combination of

a. individual's
b. politics
c. vehicles
d. a and c

18F

G. Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively.

74. Reason maglev train is quiet
a. travels at slow speed
b. cars are well design
c. the cars don't touch the tracks
d. it is well aerodynamically designed

74a. Structure, propulsion, suspension, guidance, and control work together to make a
a. space transportation system
b. air transportation system
c. vehicle system
d. intermodal transportation system
18G

H. Governmental regulations often influence the design and operation of transportation systems.

75. The Federal Aviation administration regulates this except,
a. issue licenses to pilots
b. set land speed limits
c. air space
d. air safety

75a. This often influences the design and operation of transportation
a. the public
b. Governmental regulation
c. the manufacture
d. the company
18H

I. Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently.

76. Transportation that moves many people at once and available to the general public is called
a. automobiles
b. mass transportation
c. space shuttle
d. vessel

76a. Are necessary for the entire transportation system to operate efficiently
a. routing, scheduling, loading
b. receiving, moving, unloading
c. delivering, storing, communicating
d. a, b and c
18I

Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

F. Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them.

77. The last step in metal casting is

a. preparing the material
b. introduce and solidify the material
c. extracting the part
d. prepare the mold

77a. Manufacturing process that cut, grind, or crush a material to create a form is called _

a. casting
b. manufacturing
c. Mechanical processing
d. none

19F

G. Manufactured goods may be classified as durable and non-durable.

78. Which products is an example of non-durable goods

a. hammers
b. bicycles
c. television
d. calendars

78a. Manufacturing products that can be used over a relatively long period of time are called _.

a. non-durables goods
b. primary processes
c. secondary processes
d. durable goods

19G

H. The manufacturing process includes the designing, development, making, and servicing of products and systems.

79. All of the following take place in a R & D department except

a. problem are solve through experimentation
b. products are manufactured
c. research on products in the market
d. invention and innovation

79a. The integration of people, procedures, and equipment to produce products efficiently is called a

a. transportation system
b. manufacturing system
c. construction system
d. communication system

19H

I. Chemical technologies are used to modify or alter chemical substances.

80. Chemical compound needed to make plastic
a. wood
b. salt
c. glass
d. resin

80a. Are used to modify or alter chemical substances
a. Chemical technologies
b. Construction technologies
c. Production technologies
d. none
19I

J. Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining.

81. Materials in their natural state are called
a. raw material
b. processed materials
c. manufacturing materials
d. synthetic materials

81a. Ways that living things, minerals and other elements found in the ground, sea, or air can be removed from the earth include all of the following except
a. harvesting
b. drilling
c. mining
d. experimentation
19J

K. Marketing a product involves informing the public about it as well as assisting in its sales and distribution.

82. Word of mouth advertising uses ___________ to distribute information.
a. Ads in magazines
b. radio and television
c. mail and billboards
d. individuals

82a. Marketing a product involves _____________ and _____________.
a. informing the public and internet
b. informing the public and ordering
c. selling and distribution
d. selling and building
19K

Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

83. Rules used to control how structures are built are called
a. safety rules
b. builders
c. building codes
d. standards

83a. The selection of design for structures is based on the following factor except:
a. building laws and codes
b. style and cost
c. convenience and color
d. contractor
20F

G. Structures rest on a foundation.

84. Part of the house that rest on the ground is called a
a. building site
b. footings
c. foundation
d. subfloor

84a. Foundations can be made from this material except
a. concrete
b. steel
c. water
d. wooden poles
20G

H. Some structures are temporary, while others are permanent.

85. Construction material made of cement, sand, stones, and water, used for columns, foundations, walls, and floor is called
a. concrete
b. composite
c. resin
d. fiber

85a. Building materials used for the interior and exterior of a house are:
a. brick, rock, stone, and brink veneer
b. siding, log, wood, and plywood
c. metal, wall board, concrete, and glass
d. all of the above
20H

I. Buildings generally contain a variety of subsystems.

86. A good example of utility subsystems is
a. electricity, natural gas, and water
b. natural gas, water, and insulation
c. electricity, water, and reinforced foundation
d. none

86a. Most building subsystems are referred to as ________.
a. utilities
b. appliances
c. buildings
d. groups
20I

1. A Rapid Prototyping machine uses information from drawings to create
a. CAD drawings
b. modeling software
c. three dimensional objects
d. lasers

2. It is created to meet human needs and wants.
a. Engineering
b. Math
c. Technology
d. Science

3. The modification of an existing product or system is known as
a. innovation
b. new technology
c. manufacturing
d. process

4. When you conduct a survey to find out how well a product is going to sell it is called
a. quality control
b. market research
c. scientific management
d. production

5. When a system cannot measure or control its output it is known as
a. process
b. open-loop system
c. normal flow
d. closed-loop system

6. Your computer, software, firmware, monitor, keyboard, and speakers are examples of parts of a
a. group
b. system
c. motor
d. team

7. This system requires no human intervention; it is called a/an
a. open-loop
b. system
c. feedback
d. close-loop

8. Which device does not control other devices?
a. speakers
b. a light switch
c. a garage opener
d. a remote control

9. Name two things that may happen if a part malfunctions in a product
a. It may affect the function and quality of the product.
b. You may need to replace it and spend money.
c. You may need to contact the store and the company.
d. You may affect the function and may need to replace it.

10. A restriction or requirement identified during the design phase of a product is called a/an
a. run of time
b. problem arises
c. constraint
d. design problem

11. In the decision process, recognizing the needs among the competing factors is called a
a. want b. solution
c. need **d. trade-off**

12. The method of printing that utilizes an open screen of silk, nylon, or metal mesh is called
a. ink-jet printing b. flexography
c. gravure printing **d. serigraphy**

13. The reason you should service and maintain your car is because ___________.
a. you don't want any future engine problems b. you want to save gas
c. you hear a funny noise from the engine d. you want to see the new cars

14. This device contains a microprocessor that allows your TV to change channels
a. your remote control b. your brain
c. your car keys d. the door bell

15. A system used to accurately establish a receiver's position is called a
a. compass **b. global position system (GPS)**
c. map d. globe

16. The compact disc is an evolution of
a. the telegraph b. the printer
c. the television set **d. Edison's cylindrical record**

17. Recycled cooking oil can be used in this method of transportation
a. a solar-generated electric car b. a train
c. a bio-diesel d. an airplane

18. Science explains how things work, while ___________ makes things happen
a. Technology b. History
c. Engineering d. Mathematics'

19. The following are samples of negative impacts of technology except ________.
a. air pollution b. soil erosion
c. recycling d. water pollution

20. One of the problems that technology faces in schools is because
a. **it's not available for everyone** b. it's free
c. it's expensive d. it's not improving the world

21. What title would be more descriptive of someone who woks with technology?
a. scientists b. mechanics
c. technicians d. artisans

22. To recycle means

a. to reduce pollution
b. to use again
c. to carpool
d. to send waste to landfills

23. How can technologies be used to repair damage caused by nature disasters?

a. to find new ways of reducing waste production
b. to conserve more energy
c. to reduce the use of nonrenewable resources
d. all of the above

24. Which is an advantage of a fuel cell in the environment?

a. they are cheap
b. they are practical
c. they don't pollute
d. they are easy to find

25. A method used to help crops get the right amount of water is called

a. fertilization
b. irrigation
c. monoculture farming
d. hybrid

26. The Information Age is best known for

a. the replacement of iron materials
b. the rebirth on the arts and humanities
c. manufacturing, transportation, communication, and construction
d. invention, processing, storage, and exchange of data

27. What is the name of the new transportation concept that uses both gasoline engine and an electric motor

a. hybrid cars
b. solar cars
c. locomotives
d. airplanes

28. When selecting a cellular phone, people often look for the following:

a. a small size
b. its ease of use
c. a bargain
d. all of the above

29. They start and build their work based on the earlier work and discoveries of others

a. Engineers
b. Scientists
c. Technicians
d. All of the above

30. What is the purpose of a memory card in a digital camera?

a. to take the picture
b. to store images or pictures
c. to charge the camera
d. to print the image

31. A ruler is effective in measuring the following except:

a. length
b. thickness
c. temperature
d. width

32. The profession that involves designing products or structures

a. Engineering b. Science
c. Mechanics d. Medicine

33. A software that can be used to produce a flyer or magazine is called

a. printing b. video production
c. desktop publishing d. graphic design

34. The first working design is called a

a. picture **b. prototype**
c. sketch d. model

35. In the first step of the design process, what items should be identified?

a. the needs and wants desired b. the designs and the needs
c. the problems and wants d. the solutions and the problems

36. Which involves a set of steps with different sequences that are repeated as needed?

a. criteria b. evaluating the solution
c. brainstorming **d. defining problem**

37. When a group of individuals are asked to give or provide as many solutions as possible in a short time, this is called

a. conditioning b. evaluating
c. modeling **d. brainstorming**

38. A manufacturing method that changes the shape of a material is called

a. finishing **b. forming**
c. conditioning d. combining

39. The name of the procedure used to identify the cause of the malfunction in a technological system is:

a. trouble-shooting b. researching
c. experimenting d. processing

40. The evolution of the bicycle to the motorcycle is an example of a/an

a. invention b. idea
c. innovation d. discovery

41. A way to discover new knowledge is through

a. theory b. testing
c. experimentation d. defining the problem

42. When using the engineering design process ___________ uses mathematics skills to help us understand how the design may function.

a. the prototype b. building the part
c. trial and error **d. mathematical modeling and analysis**

43. Constraints are the limitations for the design while the criteria are
a. a clear definition of the problem b. problems dealing with society
c. elements of the problem needing to be solved d. problems that can affect individuals

44. Examples of two-dimensional and three dimensional forms are:
a. sketches b. drawings
c. computer-assisted designs **d. all of the above**

45. The advantages of having a rapid prototype machine is that
a. the product is made of metal b. it is the final replica of the product
c. it is less expensive than casting **d. it creates a prototype or model sample**

46. When making a product, this method of documenting the solution should be used
a. cameras (photography) b. design portfolios (documenting via a portfolio)
c. journals (journaling) d. all of the above

47. When installing a new computer, you should use the following item
a. an almanac **b. your computer manual**
c. your TV manual d. the library

48. When installing or repairing electronic equipment, the most important thing to follow is
a. the recommended instructions b. the manual
c. the road **d. the safety procedures**

49. This device is used to diagnose and service a car
a. a computer b. technicians
c. tools d. manuals

50. A technician should have this skill in order to repair equipment
a. be able to understand the operation and maintenance
b. be able to correct the problem in minutes
c. be able to read the manual
d. none of the above

51. When a weather satellite collects raw facts and figures for a report, it is called
a. the scientific method b. research process
c. **data** d. a conclusion

52. Data collection from a damaged building can help builders
a. collect data b. conduct surveys
c. build models **d. design new and safe buildings**

53. What is a particular impact of developing a flash light that doesn't require batteries?
a. more reliability
b. it's better for the environment
c. a greater expense
d. it's better technology

54. Engineers do this to existing products and systems to determine if they are useful or not
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent

55. In the field of health and medicine, technology helps to ________________.
a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above

56. Sanitation processes used in the disposal of medical products help control ________.
a. people
b. treatment
c. disease
d. medicine

57. A vaccination that allows the body to resist disease is called
a. immunization
b. sterilization
c. food additives
d. smallpox

58. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

59. A chemical that restores nutrients in the soil?
a. irrigation
b. monoculture
c. fertilizer
d. hydrid

60. A method used by farmers to water their crops is
a. bioremediation
b. irrigation technology
c. dehydration
d. monoculture

61. The biology of plant growth in agriculture comes from this area of science:
a. plant science
b. chemical science
c. technology
d. physical science

62. ______________ are human-made systems reproducing some parts of the natural environment.
a. Dehydrations
b. Cannings
c. Artificial ecosystems
d. Chemical preservations

63. Preserving food by removing its moisture is called
a. dehydration
b. canning
c. artificial ecosystems
d. chemical preservation

64. Some form(s) of energy are
a. mechanical energy
b. electrical energy
c. chemical energy
d. All of the above

65. Gasoline, diesel, and rocket engines are samples of
a. solar powered motors
b. external combustion engines
c. internal combustion engines
d. battery powered motors

66. What measurement is used to determine how quickly the work is done?
a. horsepower
b. distance
c. power
d. rate

67. By collecting solar energy, solar panels can generate
a. electricity
b. solar energy
c. nuclear energy
d. mechanical energy

68. The act of making better use of energy is called
a. pollution
b. recycling
c. technology
d. conservation

69. The communication mode used when you play a video game is
a. people to machine
b. machine to people
c. machine to machine
d. people to people

70. The radio in your car is a(n) __________ and the radio station is the __________.
a. message, messenger
b. receiver, transmitter
c. cd player, cd
d. encoder, decoder

71. The code in which information on the World Wide Web is written
a. URL
b. browser
c. search engine
d. HTML

72. The technique used to make drawings that describes the exact size, shape, and structure of objects is called a
a. drawing
b. sketching
c. painting
d. drafting

73. The space shuttle is a transportation vehicle that is to be used in
a. land and water
b. land and space
c. air and space
d. air and land

74. The reason a maglev train is quiet is because
a. it travels at slow speeds
b. the cars are well designed
c. the cars don't touch the tracks
d. it has a good aerodynamically design

75. The Federal Aviation administration regulates all of these except __________.
a. issuing licenses to pilots **b. set land speed limits**
c. air space d. air safety

76. Transportation that moves more than six people at once and is available to the general public is called
a. automobiles **b. mass transportation**
c. space shuttle d. vessel

77. The manufacturing process that cuts, grinds, or crushes a material to create a form is called _.
a. casting b. manufacturing
c. Mechanical processing d. none

78. Which products are examples of non-durable goods?
a. hammers b. bicycles
c. television **d. calendars**

79. All of the following take place in a research and developing department except
a. problems solved through experimentation
b. the manufacturing of products
c. market research of products
d. invention and innovation

80. _________ are used to modify or alter chemical substances
a. Chemical technologies b. Construction technologies
c. Production technologies d. none

81. Materials in their natural state are called
a. raw materials b. processed materials
c. manufacturing materials d. synthetic materials

82. Marketing a product involves ______________ and ______________.
a. informing the public and internet b. informing the public and ordering
c. selling and distributing d. selling and building

83. Rules used to control how structures are built are called
a. safety rules b. builders
c. building codes d. standards

84. The part of the house that rests on the ground is called a
a. building site b. footings
c. foundation d. subfloor

85. A construction material composed of cement, sand, stone, and water that is utilized for columns, foundations, walls, and floors is called

a. concrete b. composite

c. resin d. fiber

86. Good examples of utility subsystems are:

a. electricity, natural gas, and water b. natural gas, water, and insulation

c. electricity, water, and reinforced foundation d. none

APPENDIX C: DETAILED STATISTICAL TABLES

Table 1

Control and Experimental Group Schools

School		Address
Experimental		
Griffith MS		4765 E. Fourth St., Los Angeles, CA 90022
Stevenson MS		725 S. Indiana St., Los Angeles, CA 90023
Control		
Belvedere MS		312 N. Record Ave., Los Angeles, CA 90063
Hollenbeck MS		2510 E. Sixth St., Los Angeles, CA 90023

Table 2

Comparison of Reliability Statistics for Forms A, B, and C

Form	N	Cronbach's Alpha
Form A	35	.80
Form B	35	.45
Form C	35	.64

Table 3

Correlation between Standard 1 and their Benchmarks

Subscale	0101F	0802P	0902Q	1202T	1703F	1603E
		Items	(n=6)			
0101F						
0802P	.273					
0902Q	.730	.062				
1202T	.348	.014	.163			
1703F	.651	.171	.025	.891		
1603E	.612	.818	.547	.265	.983	

Table 4

Correlation between Standard 2 and their Benchmarks

Subscale	2506D	3007E	3107E
	Items	(n=3)	
2506D			
3007E	.181		
3107E	.943	.875	

Table 5

Correlation between Standard 3 and their Benchmarks

Subscale	4110H	3609G	4010G	3910F
4110H				
3609G	.488			
4010G	.368	.962		
3910F	.320	.121	.726	

Table 6

Correlation between Standard 4 and their Benchmarks

Subscale	4812J	5213G	4511K	5412I	5012K	4211H
4812J						
5213G	.159					
4511K	.110	.074				
5412I	.214	.673	.094			
5012K	.848	.382	.548	.557		
4211H	.114	.370	.013	.000	.013	

Table 7

Correlation between Standard 5 and their Benchmarks

Subscale	7719G	8219K	7117J	5514H	6816I	8018I	5914G	5814J	8420G	6516F	6516F	7318F	7217K	6416E	8620I	7819H
7719G																
8219K	.014															
7117J	.354	.416														
5514H	.103	.573	.816													
5614H	.109	.042	.878	.968												
6816I	.821	.396	.375	.951	.002											
8018I	.002	.572	.666	.537	.608	.673										
5914G	.026	.001	.781	.303	.001	.110	.242									
5814J	.874	.004	.299	.018	.486	.528	.004	.013								
8420G	.675	.705	.781	.139	.992	.110	.123	.588	.331							
6516F	.701	.171	.583	.591	.057	.192	.484	.496	.022	.496						
7318F	.130	.557	.227	.774	.898	.785	.224	.062	.569	.668	.085					
7217K	.567	.841	.059	.372	.888	.159	.874	.278	.939	.278	.357	.554				
6416E	.911	.841	.353	.154	.746	.620	.173	.278	.668	.278	.960	.279	.796			
8620I	.701	.171	.198	.933	.396	.922	.743	.094	.227	.798	.289	.218	.960	.357		
7819H	.294	.031	.340	.556	.749	.181	.411	.347	.652	.679	.228	.423	.696	.696	.892	

Table 8

Gender of Participants in the Study

Gender of Participants	Frequency	Percent
Female	135	50
Male	137	50
N	272	100

Table 9

Test Score Statistics

Post-test	Technology Education	No Technology Education
Population	135	137
Mean	15.42	14.07
SD	5.42	5.25

Table 10

Test of Homogeneity of Variances in Scores

Levene Statistic	df1	df2	Sig.
.665	.087	271	.931

Table 11

ANOVA

Group	N	Mean	Std. Deviation	Std. Error
Tech	135	15.42	5.42	.47
No Tech	137	14.07	5.25	.45
Total	272	14.74	5.37	.32

Table 12

Analysis of Variance Between Groups

	Sum of Squares	Df	Mean Square	F	Sig.	d
Between Group	125.13	1	125.12	4.40	.037	.253
Within Groups	7679.34	270	28.44			
Total	7804.47	271				

Table 13

Comparative Scores between Males and Females

	N	Mean	Std. Deviation	Std Error
Males	134	14.79	5.55	.48
Females	138	14.69	5.20	.44
Total	272	14.74	5.37	.36

Table 14

Test of Homogeneity of Variances in Scores

Levene Statistic	df1	df2	Sig.
1.885	1	270	.171

Table 15

One-way Analysis of Variance between Test Groups Across Gender

	Sum of Squares	Df	Mean Square	F	Sig.
Between Group	.72	1	.72	.03	.875
Within Groups	7803.75	270	28.90		
Total	7804.47	271			

APPENDIX D: ITEM LOADING ON STANDARDS AND BENCHMARKS

Form A	Stan 1(1-3)	Stan 2(4-7)	Stan 3(8-10)	Stan 4(11-13)	Stan 5(14-20)
	0101F	2506D	4110H	4812J	7716G
	0802P	3007E	3609G	5213G	8219K
	0902Q	3107E	4010G	4511K	7117J
	1202T		3901F	5412I	5514H
	1703F			5012K	5614H
	1603E			4211H	6816I
					8019I
					5914G
					5814J
					8420G
					6516F
					7318F
					7217K
					6416E
					8620I
					7819H

APPENDIX E: INSTRUMENT

RE: Content Validity

Dr. XXXXXX XXXXXX,

My name is Mauricio Castillo. I am a Ph. D. student currently in the Ph. D. dissertation stage working with Dr. Michael A. De Miranda at Colorado State University. A portion of my study requires the design and testing of an assessment instrument to measure technological literacy in light of the standards for technological literacy, at the grade level 6-8 benchmarks. As part of this research, content validity of the test bank items is very important. As a recognize expert in the field of technology education I am asking you if you can please take a moment and review the items. You will be asked to review the items in light of alignment from the STL at the grade 6-8 benchmarks, clarity of the question, and relationship of the questions to what is expect it in a standard base classroom, item difficulty, and provide necessary comments. Your expertise will be use to help improve the validity of the content test items. Please feel free to make any comments or corrections that you think are appropriate and if you can please returned by May 26, 2006, I greatly appreciate that. Should you have any comments or concern, please feel free to call me at (970)420-6002 cell or mcastill@cahs.colostate.edu I will be delighted to discuss this with you. I appreciated your help in moving this part of research for technology education forward.

Sincerely,

Mauricio Castillo   Michael A. De Miranda, Ph. D.

July 21, 2006

RE: Content Validity Review

Dear XXXXXXXX,

I would like to take this opportunity to thank you for agreeing to serve as a content expert reviewer for my technology literacy assessment instrument. A portion of my study requires the design and testing of an assessment instrument to measure technological literacy in light of the Standards for Technological Literacy for grades 6-8 benchmarks. As part of this research, content validity of the test bank items is very important. Due to the length of the master item test bank and respect for your professional time, I'm asking you to review only a portion of the test bank items. Therefore, the form A and form B items you review may only address several standard benchmarks.

Your task is to review each item in light of alignment with the Standards for Technological Literacy and grade 6-8 benchmarks. For each question, please provide feedback on the following:

- Clarity and readability of each item
- Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
- Item difficulty
- Any other comments and suggestions you may have that would increase the content validity of the item.

Your input will be used to help improve the validity of the test item content. Please feel free to make any comments or corrections that you think are appropriate. Please return your response by August 7, 2006 in the enclosed self addressed stamped envelope. Your participation is greatly appreciated. Should you have any comments or concern, please call me at (970) 420-6002 or email me mcastill@cahs.colostate.edu . I appreciate your help in moving this part of research for technology education forward.

Thank you for your cooperation in this study.

Sincerely,

Mauricio Castillo

Michael A. De Miranda, Ph.D.

STL Item Test Bank Sample

The Nature of Technology

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

1. A machine called Rapid Prototyping can turn drawings into
a. CAD drawings b. modeling software
c. three dimensional objects d. laser

1a. _______________ enables people to improve current technologies or solve problems.
a. Music b. English
c. Technology d. Math
1F

G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative.

2. When you hear "You don't want to reinvent the wheel," they mean
a. do the same work again
b. look for a shorter way of improve
c. don't do the same work as others have already done.
d. think how technologically you can improve

2a. People create this to _________________ meet human needs and wants.
a. Engineering b. Math
c. Technology d. Science
1G

H. Technology is closely linked to creativity, which has resulted in innovation.

3. The modification of an existing product or system is called
a. innovation b. new technology
c. manufacturing d. process

3a. An invention can always be __________.
a. modeled b. **improved**
c. replaced d. misplaced
1H

I. Corporations can often create demand for a product by bringing it onto the market and advertising it.

4. When you conduct a survey to find out how well a product is going to sell is called
a. quality control | **b. market research**
c. scientific management | d. production

4a. When you see a commercial on TV, they are _________.
a. Promoting the product | b. testing the product
c. checking for quality of the product | d. none of the above
1I

Standard 2: Students will develop an understanding of the core concepts of technology.

M. Technological systems include input, processes, output, and at times, feedback.

5. The fuel level indicator on your car is an example of ________________.
a. not paying attention | **b. a feedback system**
c. an empty tank | d. a display indicator

5a. When a system cannot measure or control its output is called
a. process | **b. open-loop system**
c. normal flow | d. closed-loop system

5b. The end result on a product is called
a. design | b. flow
c. output | d. system
2M

N. Systems thinking involves considering how every part relates to others.

6. The purpose of a transistor in a radio is to
a. control speed | b. measure current
c. control electric current | d. control the component

6a. Your computer, monitor, keyboard, and speakers are an example of parts of a _
______.
a. group | **b. system**
c. motor | d. team
2N

O. An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback.

7. The sound or alarm of a smoke detector is a type of __________ communication.
a. people to people b. machine to machine
c. machine to people d. people to machine
7a. When a system requires human intervention it is called _______.
a. an open-loop b. a system
c. a feedback d. a close-loop
2O

P. Technological systems can be connected to one another.

8. Which device does not control other devices?
a. speakers b. light switch
c. garage opener d. remote control

8a. You can connect your VCR to what other component?
a. microwave **b. Television**
c. refrigerator d. printer
2P

Q. Malfunctions of any part of a system may affect the function and quality of the system.

9. Which statement is true about a malfunctioning system?
a. it can be prevented b. can affect our environment
c. it can be replaced **d. a and b**

9a. Name two things that may happen if something malfunction's in a product
a. May affect the function and quality of the product b. May need to replace it and spend money
c. May need to contact the store and the company d. May affect the function and may need to replace it.
2Q

R. Requirements are the parameters placed on the development of a product or system.

10. When you design a new bicycle, you should establish the following?
a. price, quality, and quantity b. quality versus quantity
c. criteria and constraints **d. a and c**

10a. A restriction or requirement identified during the design phase of a product is called
a. run of time   b. a problem arises
c. a constraint   d. design problem
2R

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

11. From the list below, which is the best trade-off for the International Space Station to recharge its battery?
a. using the sun   b. taking extra batteries in the cargo
c. nuclear energy   d. using gas engines
11a. When you choose something instead of another is an example of __________.
a. a want   b. a solution
c. a need   **d. a trade-off**
2S

T. Different technologies involve different sets of processes.

12. Method of printing using open screen of silk, nylon, or metal mesh is _______ _______.
a. ink-jet printing   b. flexography
c. gravure printing   **d. serigraphy**

12a. The two types of processes used in technological systems are _____________.
a. Managing and producing   b. output and inputs
c. planning and organizing   d. directing and controlling
2T

U. Maintenance is the process of inspecting and servicing a product or system on a regular basis in order for it to continue functioning properly, to extend its life, or to upgrade its quality.

13. When building a new school which requirements may not be required to be in a city's building code?
a. fire extinguishers   b. exit signs
c. amount of chairs   d. parking space

13a. The reason you should service and maintain your car is because ___________.
a. You want your car to last longer   b. you want to impress your friends
c. You don't want any future problems   d. you want to have a nice car
2U

V. Controls are mechanisms or particular steps that people perform using information about the system that causes systems to change

14. A process that uses commands from a computer to control a machine is called
a. computer-aid manufacturing (CAM) **b. Computerized Numerical Control (CNC)**
c. computer-integrated manufacturing (CIM) d. Just in Time (JIT)

14a. Inside this device is a microprocessor that allows your TV to change channels
a. You remote control b. your brain
c. your car keys d. the door bell
2V

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

D. Technological systems often interact with one another.

15. Systems used to accurately establish a receiver's position is a ____________.
a. compass **b. global position system (GPS)**
c. map d. globe

15a. Your computer comes with software and programs for you to have better
a. programming b. system
c. interaction d. connection
3D

E. A product, system, or environment developed for one setting may be applied to another setting.

16. The compact disc is an evolution of the
a. telegraph b. printer
c. television set **d. Edison's cylindrical record**

16a. This device has many operations such as a CD player, DVD player, and recorder.
a. Television b. CD/DVD player
c. video camera **d. computer**
3E

F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

17. Recycled cooking oil can be use in this method of transportation
a. solar-generated electric car b. train
c. grease car d. airplane

17a. In technology, you can use the knowledge gained from other field to improve others.
a. **Always** b. Sometimes
c. Never d. I don't know
3F

Technology and Society

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use.

18. Science explains how things work and while _________ makes things happen
a. Technology b. History
c. Engineering d. Mathematics'

18a. What of the following things can affects humans when using technology ____.
a. safety b. comfort
c. choices **d. flexibility**
4D

E. Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.

19. A negative affect that Communication technology creates on our environment is
a. the use of more computers **b. the use of more paper**
c. the use of more plastics d. the use of more water

19a. The following are samples of negative impacts of technology except _______.
a. air pollution b. soil erosion
c. recycling d. water pollution
4E

F. The development and use of technology poses ethical issues.

20. Technology is defined as
a. computers in the classroom b. electronic equipment that help human achieve a goal.
c. things that we use every day **d. practical use of knowledge to satisfy human wants and needs.**

20a. One of the problems that technology faces everyday is that _________.
a. **Its not available for everyone** b. Its free
c. its expensive d. Its not improving the world
4F

G. Economic, political, and cultural issues are influenced by the development and use of technology.

21. In today's society, people who work with technology are
a. Scientists
b. Mechanics
c. Technicians
d. Artisans

21a. The development of technology influence the following except ___________.
a. economics
b. demographics
c. political
d. cultural issues
4G

Standard 5: Students will develop an understanding of the effects of technology on the environment.

D. The management of waste produced by technological systems is an important societal issue.

22. To recycle means
a. to reduce pollution
b. to use again
c. to carpool
d. to send waste to landfills

22a. The following materials has decreased the waste into the landfills except ____.
a. glass
b. paper
c. aluminum
d. oil products
5D

E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems.

23. Which scenario is an example of biosynthesis?
a. using bacteria to clean to contaminated land
b. making chemicals using biological processes
c. using genetically modified organism to produce medicine
d. a human made, controlled environment

23a. How technologies can be used to repair damage caused by nature disasters?
a. by finding new ways of reducing waste production
b. by conserving more energy
c. by reducing the use of nonrenewable resources
d. all of the above
5E

F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.

24. Which is an advantage of a fuel cell?
a. they are cheap
b. they are practical
c. they don't pollute
d. they are easy to find

24a. When decisions to develop and use technologies are made. What type of damages can occur to the environment?
a. water pollution
b. soil erosion
c. noise pollution
d. all of the above
5F

Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.

25. A method that is used to help crops get the right amount of water is called ____.
a. fertilization
b. Irrigation
c. Monoculture farming
d. hybrid

25a. The invention and innovation of computing has resulted from _______ demands.
a. information
b. business
c. individual
d. all of the above
6D

E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants.

26. The Information Age is best known for
a. iron replaced metals
b. rebirth on the arts and humanities
c. manufacturing, transportation, communication, and construction
d. invention, process, storage, and exchange of data

26a. Innovation can make inventions ____________.
a. work better
b. be less expensive
c. be built with better materials
d. all of the above
6E

F. Social and cultural priorities and values are reflected in technological devices.

27. What is the name of the new transportation concept that uses both gasoline engine and electric motor

a. hybrid car | b. solar car
c. locomotives | d. airplanes

27a. Technology has changed the social and cultural ways people communicate through the use of this device

a. cellular telephone | b. printed text
c. microwave | d. none of the above

6F

G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

28. In what ways can graphic communications harm our environment?

a. by using computer | b. by using film
c. by using printing plates | **d. by using chemicals and printing inks**

28a. When selecting a cellular phone, people often want the following:

a. to be small | b. easy to use
c. inexpensive | **d. all of the above**

6G

Standard 7: Students will develop an understanding of the influence of technology on history.

C. Many inventions and innovations have evolved using slow and methodical processes of tests and refinements.

29. Start and build their work based on the earlier work and discoveries of others

a. Engineers | b. Scientists
c. Technicians | **d. All of the above**

29a. One early inventor that created plans and drawings for bicycles, helicopters, gears, and parachutes is

a. Albert Einstein | b. Isaac Newton
c. Leonardo da Vinci | d. Robert Goodyear

7C

D. The specialization of function has been at the heart of many technological improvements.

30. What is the purpose of a memory card in a digital camera?
a. takes the picture
b. store images or pictures
c. charges the camera
d. prints the image

30a. The improvement of technological devices took in some instances years because
a. no materials were available
b. of designs
c. ideas took longer to create
d. lack of inventions
7D

E. The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships.

31. A home heating and air conditioning thermostat controls
a. repair of your heater
b. money saving
c. downloaded music
d. indoor air temperature

31a. A ruler is effective in measuring the following except:
a. length
b. thickness
c. temperature
d. width
7E

F. In the past, an invention or innovation was not usually developed with the knowledge of science.

32. The profession that involves designing products or structures
a. Engineers
b. Scientists
c. Mechanics
d. Doctors

21a. Early inventions or innovations were not usually developed with the knowledge of
a. Mathematics
b. Science
c. Engineering
d. Technology
7F

Design

Standard 8: Students will develop an understanding of the attributes of design.

E. Design is a creative planning process that leads to useful products and systems.

33. When you use the computer and printer to produce a flyer or magazine is called
a. printing
b. reporter
c. desktop publishing
d. graphic design

33a. When creating a new product, you should do this first.

a. draw it
b. sketch it
c. design it
d. produce it

8E

F. There is no perfect design.

34. The process that follows identifying a problem is called

a. Research and Design
b. Brainstorming
c. Establishing criteria
d. Thinking

34a. A prototype is _______________.

a. a picture
b. the first working design
c. a sketch
d. a model

8F

G. Requirements for design are made up of criteria and constraints.

35. Which department is in charge of the research and development of new ideas

a. Business department
b. Quality and Control department
c. Help desk development
d. Research and Development department

35a. In the first step of the design process what items should be identified first.

a. the desired needs and wants
b. the designs and the needs
c. the problems and wants
d. the solutions and the problems

8G

Standard 9: Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

36. One of the first steps in the problem solving process is

a. Criteria
b. evaluation the solution
c. brainstorming
d. Define problem

36a. Each design problem is unique and may require

a. different procedures
b. steps in different sequences
c. team effort
d. a, b and c

9F

G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.

37. The technique that helps you to solve a problem rapidly is called
a. Criteria
b. evaluation the solution
c. constraints
d. brainstorming

37a. When a group is asked to give or provide as many solutions as possible in a short time is called
a. Criteria
b. evaluation the solution
c. constraints
d. brainstorming
9G

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

38. A method that changes the shape of a material is called _______.
a. finishing
b. forming
c. conditioning
d. combining

38a. It's used to communicate ideas in a three-dimensional copy of a new product.
a. drawing
b. two dimensional drawing
c. a model
d. sketches
9H

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.

39. Before a new product is sent to production, it should be_____________.
a. evaluated the solution and market the product
b. prototyped and tested
c. market the product and test it
d. define the problem and create a prototype

39a. The name of the procedure used to identify the cause of the malfunction in a technological system is:
a. trouble shooting
b. collect information
c. experiment
d. process
10F

G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.

40. An invention is turning ideas and imagination into a new device, while an innovation is
a. turning ideas turns into a creation
b. the design of equipment
c. being repaired to make it work
d. modify existing product or system

40a. The evolution of the bicycle to motorcycle is an example of
a. an invention
b. an idea
c. an innovation
d. a discover
10G

H. Some technological problems are best solved through experimentation.

41. An ______________ is a controlled way to discover new knowledge
a. theory
b. trial and error
c. experiment
d. defining the problem

41a. In technology, the method used to solve some technological problems is through experimentations, which other method is similar to experimentation
a. hypothesis method
b. scientific method
c. theory method
d. testing method
10H

Abilities for a Technological World

Standard 11: Students will develop abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

42. Plastic that can be heated and shaped one time only are called
a. thermosetting plastics
b. inorganic materials
c. organic materials
d. Metals

42a. When using the engineering design process ___________ uses math skills to help us understand how the design may function.
a. the prototype
b. building the part
c. trial and error
d. mathematical modeling and analysis
11H

I. Specify criteria and constraints for the design.

43. One of the most popular building materials used in the U.S. is
a. metal **b. wood**
c. ceramics d. composites

43a. Constraints are the limitations for the design while the criteria are
a. a clear definition of the problem b. problems dealing with society
c. elements of the problem needing to be solved d. problems that can affect individuals
11I

J. Make two-dimensional and three-dimensional representations of the designed solution.

44. A program that can create virtual models using visual software is called
a. computerized numerical control program (CNC) **b. computer-aided drafting program (CAD)**
c. Photoshop d. SPSS program

44a. Examples of two-dimensional and three dimensional forms are:
a. sketches b. drawings
c. computer-assisted designs **d. all of the above**
11J

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

45. The advantages of a rapid prototype machine
a. the product is made of metal b. is the final replica of the product
c. is more expense than casting **d. it creates a prototype or model in a few minutes**

45a. One of the many sources a designer receives information on how to improve the design is through:
a. customer's b. government agencies
c. competitors **d. all of the above**
11K

L. Make a product or system and document the solution.

46. The software you can use to present text, graphics, and other media is called
a. writing software b. computer-aided design software (CAD)
c. presentation software d. drawing software

46a. When making a product you should use all of these methods to document the solution.

a. camera
b. design portfolios
c. journals
d. all of the above

11L

Standard 12: Students will develop abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

47. Whenever you have a problem with an appliance at your home, you should first refer to

a. the library
b. the help desk
c. the appliance manual
d. the teacher

47a. When installing a new computer, you should use the following item

a. almanac
b. your computer manual
c. your TV manual
d. your instincts

12H

I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems.

48. Most automotive repair shops use this to diagnose a problem in a cars computer control system.

a. books
b. manuals
c. computer scanner
d. technician

48a. When installing or repairing electronic equipment the most important thing to follow are

a. the recommended instructions
b. the manual
c. the road
d. the safety procedures

12I

J. Use computers and calculators in various applications.

49. The microwave oven is an example of

a. an analog device
b. a digital device
c. transmitter
d. laser

49a. Most new cars use this device to control and service the car

a. computers
b. technicians
c. tools
d. manuals

12J

K. Operate and maintain systems in order to achieve a given purpose.

50. Electronic signals can be sent through the following except
a. wire
b. electromagnetic waves
c. optic cables
d. wood

50a. Some of the skills a technician should have to repair equipment should be
a. understand the operation and maintenance
b. correct the problem
c. read the manual
d. none of the above
12K

Standard 13: Students will develop abilities to assess the impact of products and systems.

F. Design and use instruments to gather data.

51. The best way to test a solution is by
a. trial and error
b. put the solution to work
c. market the product
d. define the problem

51a. When a weather satellite collects raw facts and figures for a report, it is called
a. scientific method
b. research process
c. **Data**
d. conclusion
13F

G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology.

52. To be able to use and understand technology is to be
a. a scientist
b. technological literate
c. an engineer
d. smart

52a. Data collected from buildings during a hurricane can help builders
a. collect data
b. conduct surveys
c. build models
d. design new material and building techniques
13G

H. Identify trends and monitor potential consequences of technological development.

53. This method helps identify the cause of a malfunction
a. troubleshooting
b. prototype and test it
c. engineering
d. constraints

53a. A trend in communication, especially in cellular phones and consumers is phones
a. need to be built bigger
b. do not need a camera
c. need to be one color only
d. need to be smaller and lighter
13H

I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful.

54. What method should you use to decide which product is better that the other?
a. collect more information
b. test them
c. read about it
d. an evaluation experiment

54a. Engineers do this to existing products and systems to determine if they useful or not.
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent
13I

The Designed World

Standard 14: Students will develop an understanding of and be able to select and use medical technologies.

G. Advances and innovations in medical technologies are used to improve healthcare.

55. A heart monitoring machine is an electronic device that changes one form of energy to another; from sound to
a. water
b. laser
c. an electric signal
d. air

55a. By using technology, health care professional help people _________.
a. with side affects
b. with their problems
c. live better lives
c. live longer

55b. In the field of health and medicine, technology helps to __________________.
a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above
14G

H. Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety.

56. A method that achieves very clean tools and equipment in the hospital?
a. Pasteurization
b. sterilization
c. irradiation
d. sanitation

56a. Sanitation processes used in the disposal of medical products help control _________.

a. people
b. treatment
c. disease
d. medicine

14H

I. The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccines is produced.

57. Is a vaccination that makes the body resist to disease

a. immunization
b. vaccine
c. food additives
d. smallpox

57a. Vaccines are special drugs created to prevent diseases from affecting

a. computers
b. equipment
c. people
d. none of the above

14I

J. Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups.

58. A method that modifies the generic material in DNA in order to cure a disease?

a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

58a. Genetic engineering is done _________.

a. at home
b. at a school
c. in a laboratory
d. at an unsafe place

14J

Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

F. Technological advances in agriculture directly affect the time and number of people required to produce food for a large population.

59. Is a chemical that restores nutrients to the soil?

a. irrigation
b. monoculture
c. fertilizer
d. hydrid

59a. Technological advances allow people to grow food _______________.

a. in bigger machines
b. in better fields
c. in shorter periods of time
d. in more time

15F

G. A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals.

60. A method use by farmers to water their crops is
a. bioremediation
b. irrigation technology
c. dehydrated
d. monoculture

60a. Biotechnology deals with using biology principles and processes to
a. harm the crops
b. produce commercial goods or services
c. create diseases
d. none of the above
15G

H. Biotechnology applies the principles of biology to create commercial products or processes.

61. The biology of plant growth in agriculture comes from this area of science
a. plant science
b. chemical science
c. technology
d. physical science

61a. Bioconversion is a type of ________________.
a. biotechnology
b. manufacturing technology
c. transportation technology
d. construction technology
15H

I. Artificial ecosystems are human-made complexes that replicate some aspects of the natural environment.

62. Re-circulates water and fertilizer to grow plants
a. hydroponics
b. aquaculture
c. agroforestry
d. biotechnology

62a. ______________ are human-made systems reproducing some parts of the natural environment.
a. dehydration
b. canning
c. artificial ecosystems
d. chemical preservation
15I

J. The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food.

63. An example of dehydrated food is
a. apples
b. pizza
c. cheese
d. cookies

63a. Preserving food by removing its moisture is called _________.
a. dehydration b. canning
c. artificial ecosystems d. chemical preservation
15J

Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.

E. Energy is the capacity to do work.

64. Some forms of energy are
a. mechanical energy b. electrical energy
c. chemical energy **d. All of the above**

64a. When force is used to move an object, this is produced _________.
a. energy b. power
c. heat energy **d. work**
16E

F. Energy can be used to do work, using many processes.

65. Gasoline, diesel, and rocket engines are sample of
a. solar powered motor b. external combustion engines
c. internal combustion engines d. battery powered motor

65a. It can be used to powers our cars, trains, and planes and lights our homes, stores, and offices.
a. work b. muscle
c. energy d. power
16F

G. Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done.

66. What measurement is use to determine how quickly the work is done?
a. horsepower b. distance
c. power **d. rate**

66a. Is a measure that is generally expressed in wattage or horsepower?
a. distance b. energy
c. volume **d. power**
16G

H. Power systems are used to drive and provide propulsion to other technological products and systems.

67. By collecting solar energy, solar panels can generate
a. electricity b. solar energy
c. nuclear energy d. mechanical energy

67a. Chances wind energy into electrical energy
a. wind generator b. power system
c. engine d. battery
16H

I. Much of the energy used in our environment is not used efficiently.

68. Which of the following is not a way to conserve more energy?
a. carpooling b. insulation
c. turn off lights **d. leaving the lights on**

68a. The act of making better use of energy is called ___________.
a. polluting b. recycling
c. technology **d. conservation**
16I

Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

H. Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human.

69. The communication mode used when you play a video game is
a. people to machine b. machine to people
c. machine to machine d. people to people

69a. Talking to your friends at school is an example of _______________ communication.
a. people to people b. machine to people
c. machine to machine d. people to machine
17H

I. Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination.

70. The radio in your car is a __________ and the radio station is the _________.
a. message, messenger **b. receiver, transmitter**
c. cd player, cd d. encoder, decoder

70a. Which of the following devices change a signal from an analog to digital
a. video camera b. motherboard
c. hardrive **d. keys on the keyboard**
17I

J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

71. The code in which information on the World Wide Web is written
a. URL b. browser
c. search engine **d. HTML**

71a. The following technologies help handicapped people communicate except
a. audiotapes b. internet
c. closed-captured television **d. hand signals**
17J

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

72. The technique used to make drawing that describe the exact size, shape, and structure of objects is called
a. drafting b. sketching
c. painting d. drawing

72a. The way we communicate ideas in a technological system is by
a. speaking and writing b. drawing, photos and symbols
c. by looking in the mirror **d. a and b**
17K

Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.

F. Transporting people and goods involves a combination of individuals and vehicles.

73. The space shuttle is a ______________________ transportation vehicle.
a. land and water b. land and space
c. air and space d. air and land

73a. Transporting people and goods involves a combination of
a. individual's b. politics
c. vehicles **d. a and c**
18F

G. Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively.

74. Reason maglev train is quiet
a. travels at slow speed
b. cars are well design
c. the cars don't touch the tracks
d. it is well aerodynamically designed

74a. Structure, propulsion, suspension, guidance, and control work together to make a
a. space transportation system
b. air transportation system
c. vehicle system
d. intermodal transportation system
18G

H. Governmental regulations often influence the design and operation of transportation systems.

75. The Federal Aviation administration regulates this except,
a. issue licenses to pilots
b. set land speed limits
c. air space
d. air safety

75a. This often influences the design and operation of transportation
a. the public
b. Governmental regulation
c. the manufacture
d. the company
18H

I. Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently.

76. Transportation that moves many people at once and available to the general public is called
a. automobiles
b. mass transportation
c. space shuttle
d. vessel

76a. Are necessary for the entire transportation system to operate efficiently
a. routing, scheduling, loading
b. receiving, moving, unloading
c. delivering, storing, communicating
d. a, b and c
18I

Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

F. Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them.

77. The last step in metal casting is
a. preparing the material   b. introduce and solidify the material
c. extracting the part   d. prepare the mold

77a. Manufacturing process that cut, grind, or crush a material to create a form is called _
a. casting   b. manufacturing
c. Mechanical processing   d. none
19F

G. Manufactured goods may be classified as durable and non-durable.

78. Which products is an example of non-durable goods
a. hammers   b. bicycles
c. television   **d. calendars**

78a. Manufacturing products that can be used over a relatively long period of time are called _.
a. non-durables goods   b. primary processes
c. secondary processes   **d. durable goods**
19G

H. The manufacturing process includes the designing, development, making, and servicing of products and systems.

79. All of the following take place in a R & D department except
a. problem are solve through experimentation
b. products are manufactured
c. research on products in the market
d. invention and innovation

79a. The integration of people, procedures, and equipment to produce products efficiently is called a
a. transportation system   **b. manufacturing system**
c. construction system   d. communication system
19H

I. Chemical technologies are used to modify or alter chemical substances.

80. Chemical compound needed to make plastic

a. wood
b. salt
c. glass
d. resin

80a. Are used to modify or alter chemical substances

a. Chemical technologies
b. Construction technologies
c. Production technologies
d. none

19I

J. Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining.

81. Materials in their natural state are called

a. raw material
b. processed materials
c. manufacturing materials
d. synthetic materials

81a. Ways that living things, minerals and other elements found in the ground, sea, or air can be removed from the earth include all of the following except

a. harvesting
b. drilling
c. mining
d. experimentation

19J

K. Marketing a product involves informing the public about it as well as assisting in its sales and distribution.

82. Word of mouth advertising uses ____________ to distribute information.

a. Ads in magazines
b. radio and television
c. mail and billboards
d. individuals

82a. Marketing a product involves ______________ and ______________.

a. informing the public and internet
b. informing the public and ordering
c. selling and distribution
d. selling and building

19K

Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

83. Rules used to control how structures are built are called

a. safety rules
b. builders
c. building codes
d. standards

83a. The selection of design for structures is based on the following factor except:
a. building laws and codes
b. style and cost
c. convenience and color
d. contractor
20F

G. Structures rest on a foundation.

84. Part of the house that rest on the ground is called a
a. building site
b. footings
c. foundation
d. subfloor

84a. Foundations can be made from this material except
a. concrete
b. steel
c. water
d. wooden poles
20G

H. Some structures are temporary, while others are permanent.

85. Construction material made of cement, sand, stones, and water, used for columns, foundations, walls, and floor is called
a. concrete
b. composite
c. resin
d. fiber

85a. Building materials used for the interior and exterior of a house are:
a. brick, rock, stone, and brink veneer
b. siding, log, wood, and plywood
c. metal, wall board, concrete, and glass
d. all of the above
20H

I. Buildings generally contain a variety of subsystems.

86. A good example of utility subsystems is
a. electricity, natural gas, and water
b. natural gas, water, and insulation
c. electricity, water, and reinforced foundation
d. none

86a. Most building subsystems are referred to as _________.
a. utilities
b. appliances
c. buildings
d. groups
20I

Content Validity Item Test Bank

The Nature of Technology

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

1. A machine called Rapid Prototyping can turn drawings into
a. CAD drawings
b. modeling software
c. three dimensional objects
d. laser

1a. ________________ enables people to improve current technologies or solve problems.
a. Music b. English
c. Technology d. Math
1F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
____
____
____
____
____

G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative.

2. When you hear "You don't want to reinvent the wheel," they mean
a. do the same work again
b. look for a shorter way of improve
c. don't do the same work as others have already done.
d. think how technologically you can improve

2a. People create this to meet human needs and wants.
a. Engineering b. Math
c. Technology d. Science
1G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
____
____
____
____
____

H. Technology is closely linked to creativity, which has resulted in innovation.

3. The modification of an existing product or system is called

a. innovation	b. new technology
c. manufacturing	d. process

3a. An invention can always be __________.

a. modeled	**b. improved**
c. replaced	d. misplaced

1H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. Corporations can often create demand for a product by bringing it onto the market and advertising it.

4. When you conduct a survey to find out how well a product is going to sell is called

a. quality control	**b. market research**
c. scientific management	d. production

4a. When you see a commercial on TV, they are

______________.

a. Promoting the product
b. testing the product
c. checking for quality of the product
d. none of the above
1I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 2: Students will develop an understanding of the core concepts of technology.

M. Technological systems include input, processes, output, and at times, feedback.

5. The fuel level indicator on your car is an example of ___________________.

a. not paying attention	**b. a feedback system**
c. an empty tank	d. a display indicator

5a. When a system cannot measure or control its output is called

a. process	**b. open-loop system**
c. normal flow	d. closed-loop system

5b. The end result on a product is called

a. design	b. flow
c. output	d. system

2M

Clarity and Readability
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

N. Systems thinking involves considering how every part relates to others.

6. The purpose of a transistor in a radio is to
a. control speed
b. measure current
c. control electric current
d. control the component

6a. Your computer, monitor, keyboard, and speakers are an example of parts of a ______.

a. group	**b. system**
c. motor	d. team

2N

Clarity and Readability
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 — Medium 7 6 5 4 — Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

O. An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback.

7. The sound or alarm of a smoke detector is a type of ________ communication.
a. people to people
b. machine to machine
c. machine to people
d. people to machine

7a. When a system requires human intervention it is called ____________.
a. an open-loop b. a system
c. a feedback d. a close-loop
2O

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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P. Technological systems can be connected to one another.

8. Which device does not control other devices?
a. speakers b. light switch
c. garage opener d. remote control

8a. You can connect your VCR to what other component?
a. microwave **b. Television**
c. refrigerator d. printer
2P

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Q. Malfunctions of any part of a system may affect the function and quality of the system.

9. Which statement is true about a malfunctioning system?
a. it can be prevented
b. can affect our environment
c. it can be replaced
d. a and b

9a. Name two things that may happen if something malfunction's in a product
a. May affect the function and quality of the product
b. May need to replace it and spend money
c. May need to contact the store and the company
d. May affect the function and may need to replace it

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________
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R. Requirements are the parameters placed on the development of a product or system.

10. When you design a new bicycle, you should establish the following?
a. price, quality, and quantity
b. quality versus quantity
c. criteria and constraints
d. a and c

10a. A restriction or requirement identified during the design phase of a product is called

_____________.

a. run of time
b. a problem arises
c. a constraint
d. design problem
2R

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________
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S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

11. From the list below, which is the best trade-off for the International Space Station to recharge its battery?
a. using the sun
b. taking extra batteries in the cargo
c. nuclear energy
d. using gas engines

11a. When you choose something instead of another is an example of ________.
a. a want b. a solution
c. a need **d. a trade-off**
2S

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

T. Different technologies involve different sets of processes.

12. Method of printing using open screen of silk, nylon, or metal mesh is ________________.
a. ink-jet printing b. flexography
c. gravure printing **d. serigraphy**

12a. The two types of processes used in technological systems are _______________.
a. Managing and producing
b. output and inputs
c. planning and organizing
d. directing and controlling
2T

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

U. Maintenance is the process of inspecting and servicing a product or system on a regular basis in order for it to continue functioning properly, to extend its life, or to upgrade its quality.

13. When building a new school which requirements may not be required to be in a city's building code?
a. fire extinguishers b. exit signs
c. amount of chairs d. parking space

13a. The reason you should service and maintain your car is because ____________.
a. You want your car to last longer
b. you want to impress your friends
c. You don't want any future problems
d. you want to have a nice car
2U

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

V. Controls are mechanisms or particular steps that people perform using information about the system that causes systems to change

14. A process that uses commands from a computer to control a machine is called
a. computer-aid manufacturing (CAM)
b. Computerized Numerical Control (CNC)
c. computer-integrated manufacturing (CIM)
d. Just in Time (JIT)

14a. Inside this device is a microprocessor that allows your TV to change channels
a. You remote control
b. your brain
c. your car keys
d. the door bell
2V

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

D. Technological systems often interact with one another.

15. Systems used to accurately establish a receiver's position is a ________________.
a. compass
b. global position system (GPS)
c. map
d. globe

15a. Your computer comes with software and programs for you to have better
a. programming b. system
c. interaction d. connection
3D

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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E. A product, system, or environment developed for one setting may be applied to another setting.

16. The compact disc is an evolution of the
a. telegraph
b. printer
c. television set
d. Edison's cylindrical record

16a. This device has many operations such as a CD player, DVD player, and recorder.
a. Television b. CD/DVD player
c. video camera **d. computer**
3E

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

17. Recycled cooking oil can be use in this method of transportation
a. solar-generated electric car
b. train
c. grease car
d. airplane

17a. In technology, you can use the knowledge gained from other field to improve others.
a. Always
b. Sometimes
c. Never
d. I don't know
3F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Technology and Society

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use.

18. Science explains how things work and while ______________ makes things happen

a. Technology	b. History
c. Engineering	d. Mathematics'

18a. What of the following things can affects humans when using technology __________.

a. safety	b. comfort
c. choices	**d. flexibility**

4D

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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E. Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.

19. A negative affect that Communication technology creates on our environment is
a. the use of more computers
b. the use of more paper
c. the use of more plastics
d. the use of more water

19a. The following are samples of negative impacts of technology except ____________.

a. air pollution	b. soil erosion
c. recycling	d. water pollution

4E

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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F. The development and use of technology poses ethical issues.

20. Technology is defined as
a. computers in the classroom
b. electronic equipment that help human achieve a goal.
c. things that we use every day
d. practical use of knowledge to satisfy human wants and needs.

20a. One of the problems that technology faces everyday is that ________.
a. Its not available for everyone
b. Its free
c. its expensive
d. Its not improving the world
4F

Clarity and Readability
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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G. Economic, political, and cultural issues are influenced by the development and use of technology.

21. In today's society, people who work with technology are
a. Scientists
b. Mechanics
c. Technicians
d. Artisans

21a. The development of technology influence the following except ___________.
a. economics
b. demographics
c. political
d. cultural issues
4G

Clarity and Readability
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Standard 5: Students will develop an understanding of the effects of technology on the environment.

D. The management of waste produced by technological systems is an important societal issue.

22. To recycle means
a. to reduce pollution **b. to use again**
c. to carpool d. to send waste to landfills

22a. The following materials has decreased the waste into the landfills except ___________.
a. glass b. paper
c. aluminum **d. oil products**
5D

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems.

23. Which scenario is an example of biosynthesis?
a. using bacteria to clean to contaminated land
b. making chemicals using biological processes
c. using genetically modified organism to produce medicine
d. a human made, controlled environment

23a. How technologies can be used to repair damage caused by nature disasters?
a. by finding new ways of reducing waste production
b. by conserving more energy
c. by reducing the use of nonrenewable resources
d. all of the above
5E

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.

24. Which is an advantage of a fuel cell?
a. they are cheap b. they are practical
c. they don't pollute d. they are easy to find

24a. When decisions to develop and use technologies are made. What type of damages can occur to the environment?
a. water pollution b. soil erosion
c. noise pollution **d. all of the above**
5F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

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Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.

25. A method that is used to help crops get the right amount of water is called ___________.
a. fertilization **b. Irrigation**
c. Monoculture farming d. hybrid

25a. The invention and innovation of computing has resulted from ______________ demands.
a. information b. business
c. individual **d. all of the above**
6D

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

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E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants.

26. The Information Age is best known for
a. iron replaced metals
b. rebirth on the arts and humanities
c. manufacturing, transportation, communication, and construction
d. invention, process, storage, and exchange of data

26a. Innovation can make inventions ______ ______________.
a. work better
b. be less expensive
c. be built with better materials
d. all of the above
6E

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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F. Social and cultural priorities and values are reflected in technological devices.

27. What is the name of the new transportation concept that uses both gasoline engine and electric motor?
a. hybrid car b. solar car
c. locomotives d. airplanes

27a. Technology has changed the social and cultural ways people communicate through the use of this device
a. cellular telephone b. printed text
c. microwave d. none of the above
6F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

28. In what ways can graphic communications harm our environment?
a. by using computer
b. by using film
c. by using printing plates
d. by using chemicals and printing inks

28a. When selecting a cellular phone, people often want the following:

a. to be small	b. easy to use
c. inexpensive	**d. all of the above**

6G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Standard 7: Students will develop an understanding of the influence of technology on history.

C. Many inventions and innovations have evolved using slow and methodical processes of tests and refinements.

29. Start and build their work based on the earlier work and discoveries of others

a. Engineers	b. Scientists
c. Technicians	**d. All of the above**

29a. One early inventor that created plans and drawings for bicycles, helicopters, gears, and parachutes is

a. Albert Einstein	b. Isaac Newton
c. Leonardo da Vinci	d. Robert Goodyear

7C

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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D. The specialization of function has been at the heart of many technological improvements.

30. What is the purpose of a memory card in a digital camera?
a. takes the picture
b. store images or pictures
c. charges the camera
d. prints the image

30a. The improvement of technological devices took in some instances years because
a. no materials were available
b. of designs
c. ideas took longer to create
d. lack of inventions
7D

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

E. The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships.

31. A home heating and air conditioning thermostat controls
a. repair of your heater
b. money saving
c. downloaded music
d. indoor air temperature

31a. A ruler is effective in measuring the following except:
a. length
b. thickness
c. temperature
d. width
7E

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

F. In the past, an invention or innovation was not usually developed with the knowledge of science.

32. The profession that involves designing products or structures

a. Engineers	b. Scientists
c. Mechanics	d. Doctors

32a. Early inventions or innovations were not usually developed with the knowledge of ___________.

a. Mathematics	**b. Science**
c. Engineering	d. Technology

7F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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Item Difficulty
Rating

High	Medium	Low
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Item needs revision YES NO
Proposed Revision ____________________

Design

Standard 8: Students will develop an understanding of the attributes of design.

E. Design is a creative planning process that leads to useful products and systems.

33. When you use the computer and printer to produce a flyer or magazine is called

a. printing	b. reporter
c. desktop publishing	d. graphic design

33a. When creating a new product, you should do this first.

a. draw it	b. **sketch it**
c. design it	d. produce it

8E

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

F. There is no perfect design.

34. The process that follows identifying a problem is called
a. Research and Design
b. Brainstorming
c. Establishing criteria
d. Thinking

34a. A prototype is ____________________.
a. a picture
b. the first working design
c. a sketch
d. a model
8F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Requirements for design are made up of criteria and constraints.

35. Which department is in charge of the research and development of new ideas
a. Business department
b. Quality and Control department
c. Help desk development
d. Research and Development department

35a. In the first step of the design process what items should be identified first.
a. the desired needs and wants
b. the designs and the needs
c. the problems and wants
d. the solutions and the problems
8G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 9: Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

36. One of the first steps in the problem solving process is
a. Criteria
b. evaluation the solution
c. brainstorming
d. Define problem

36a. Each design problem is unique and may require
a. different procedures
b. steps in different sequences
c. team effort
d. **a, b and c**
9F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.

37. The technique that helps you to solve a problem rapidly is called
a. Criteria
b. evaluation the solution
c. constraints
d. brainstorming

37a. When a group is asked to give or provide as many solutions as possible in a short time is called
a. Criteria
b. evaluation the solution
c. constraints
d. brainstorming
9G

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

38. A method that changes the shape of a material is called ________.
a. finishing **b. forming**
c. conditioning d. combining

38a. It's used to communicate ideas in a three-dimensional copy of a new product.
a. drawing
b. two dimensional drawing
c. a model
d. sketches
9H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.

39. Before a new product is sent to production, it should be____________________.
a. evaluated the solution and market the product
b. prototyped and tested
c. market the product and test it
d. define the problem and create a prototype

39a. The name of the procedure used to identify the cause of the malfunction in a technological system is:
a. trouble shooting
b. collect information
c. experiment
d. process
10F

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.

40. An invention is turning ideas and imagination into a new device, while an innovation is
a. turning ideas turns into a creation
b. the design of equipment
c. being repaired to make it work
d. modify existing product or system

40a. The evolution of the bicycle to motorcycle is an example of
a. an invention
b. an idea
c. an innovation
d. a discover
10G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Some technological problems are best solved through experimentation.

41. An ______________ is a controlled way to discover new knowledge

a. theory
b. trial and error
c. experiment
d. defining the problem

41a. In technology, the method used to solve some technological problems is through experimentations, which other method is similar to experimentation

a. hypothesis method
b. scientific method
c. theory method
d. testing method

10H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Abilities for a Technological World

Standard 11: Students will develop abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

42. Plastic that can be heated and shaped one time only are called
a. thermosetting plastics
b. inorganic materials
c. organic materials
d. Metals

42a. When using the engineering design process ___________ uses math skills to help us understand how the design may function.
a. the prototype
b. building the part
c. trial and error
d. mathematical modeling and analysis
11H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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I. Specify criteria and constraints for the design.

43. One of the most popular building materials used in the U.S. is
a. metal **b. wood**
c. ceramics d. composites

43a. Constraints are the limitations for the design while the criteria are
a. a clear definition of the problem
b. problems dealing with society
c. elements of the problem needing to be solved
d. problems that can affect individuals
11I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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J. Make two-dimensional and three-dimensional representations of the designed solution.

44. A program that can create virtual models using visual software is called
a. computerized numerical control program (CNC)
b. computer-aided drafting program (CAD)
c. Photoshop
d. SPSS program

44a. Examples of two-dimensional and three dimensional forms are:
a. sketches
b. drawings
c. computer-assisted designs
d. all of the above
11J

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
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High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

45. The advantages of a rapid prototype machine
a. the product is made of metal
b. is the final replica of the product
c. is more expense than casting
d. it creates a prototype or model in a few minutes

45a. One of the many sources a designer receives information on how to improve the design is through:
a. customer's
b. government agencies
c. competitors
d. all of the above
11K

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

L. Make a product or system and document the solution.

46. The software you can use to present text, graphics, and other media is called
a. writing software
b. computer-aided design software (CAD)
c. presentation software
d. drawing software

46a. When making a product you should use all of these methods to document the solution.
a. camera
b. design portfolios
c. journals
d. all of the above
11L

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 12: Students will develop abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

47. Whenever you have a problem with an appliance at your home, you should first refer to
a. the library
b. the help desk
c. the appliance manual
d. the teacher

47a. When installing a new computer, you should use the following item
a. almanac
b. your computer manual
c. your TV manual
d. your instincts
12H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems.

48. Most automotive repair shops use this to diagnose a problem in a cars computer control system.

a. books b. manuals

c. computer scanner d. technician

48a. When installing or repairing electronic equipment the most important thing to follow are

a. the recommended instructions

b. the manual

c. the road

d. the safety procedures

12I

Clarity and Readability

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO

Proposed Revision ____________________

J. Use computers and calculators in various applications.

49. The microwave oven is an example of

a. an analog device

b. a digital device

c. transmitter

d. laser

49a. Most new cars use this device to control and service the car

a. computers b. technicians

c. tools d. manuals

12J

Clarity and Readability

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty

Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO

Proposed Revision ____________________

K. Operate and maintain systems in order to achieve a given purpose.

50. Electronic signals can be sent through the following except
a. wire
b. electromagnetic waves
c. optic cables
d. wood

50a. Some of the skills a technician should have to repair equipment should be
a. understand the operation and maintenance
b. correct the problem
c. read the manual
d. none of the above
12K

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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Standard 13: Students will develop abilities to assess the impact of products and systems.

F. Design and use instruments to gather data.

51. The best way to test a solution is by
a. trial and error
b. put the solution to work
c. market the product
d. define the problem

51a. When a weather satellite collects raw facts and figures for a report, it is called
a. scientific method
b. research process
c. Data
d. conclusion
13F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology.

52. To be able to use and understand technology is to be
a. a scientist
b. technological literate
c. an engineer
d. smart

52a. Data collected from buildings during a hurricane can help builders
a. collect data
b. conduct surveys
c. build models
d. design new material and building techniques
13G

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Identify trends and monitor potential consequences of technological development.

53. This method helps identify the cause of a malfunction
a. troubleshooting
b. prototype and test it
c. engineering
d. constraints

53a. A trend in communication, especially in cellular phones and consumers is phones
a. need to be built bigger
b. do not need a camera
c. need to be one color only
d. need to be smaller and lighter
13H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful.

54. What method should you use to decide which product is better that the other?
a. collect more information
b. test them
c. read about it
d. an evaluation experiment

54a. Engineers do this to existing products and systems to determine if they useful or not.
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent
13I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

The Designed World

Standard 14: Students will develop an understanding of and be able to select and use medical technologies.

G. Advances and innovations in medical technologies are used to improve healthcare.

55. A heart monitoring machine is an electronic device that changes one form of energy to another; from sound to
a. water b. laser
c. an electric signal d. air

55a. By using technology, health care professional help people ________.
a. with side affects
b. with their problems
c. live better lives
d. live longer

55b. In the field of health and medicine, technology helps to ____________.
a. treat illnesses b. prevent illness
c. diagnose diseases **d. all of the above**
14G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety.

56. A method that achieves very clean tools and equipment in the hospital?

a. Pasteurization	**b. sterilization**
c. irradiation	d. sanitation

56a. Sanitation processes used in the disposal of medical products help control _________.

a. people	b. treatment
c. disease	d. medicine

14H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccines is produced.

57. Is a vaccination that makes the body resist to disease

a. immunization	b. vaccine
c. food additives	d. smallpox

57a. Vaccines are special drugs created to prevent diseases from affecting

a. computers	b. equipment
c. people	d. none of the above

14I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

J. Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups.

58. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

58a. Genetic engineering is done __.
a. at home
b. at a school
c. in a laboratory
d. at an unsafe place
14J

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

F. Technological advances in agriculture directly affect the time and number of people required to produce food for a large population.

59. Is a chemical that restores nutrients to the soil?
a. irrigation
b. monoculture
c. fertilizer
d. hydrid

59a. Technological advances allow people to grow food ____________________.
a. in bigger machines
b. in better fields
c. in shorter periods of time
d. in more time
15F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals.

60. A method use by farmers to water their crops is
a. bioremediation
b. irrigation technology
c. dehydrated
d. monoculture

60a. Biotechnology deals with using biology principles and processes to
a. harm the crops
b. produce commercial goods or services
c. create diseases
d. none of the above
15G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Biotechnology applies the principles of biology to create commercial products or processes.

61. The biology of plant growth in agriculture comes from this area of science
a. plant science
b. chemical science
c. technology
d. physical science

61a. Bioconversion is a type of ____________________.
a. biotechnology
b. manufacturing technology
c. transportation technology
d. construction technology
15H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. Artificial ecosystems are human-made complexes that replicate some aspects of the natural environment.

62. Re-circulates water and fertilizer to grow plants

a. hydroponics	b. aquaculture
c. agroforestry	d. biotechnology

62a. ________________ are human-made systems reproducing some parts of the natural environment.

a. dehydration	b. canning
c. artificial ecosystems	d. chemical preservation

15I

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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J. The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food.

63. An example of dehydrated food is

a. apples	b. pizza
c. cheese	d. cookies

63a. Preserving food by removing its moisture is called _________.

a. dehydration	b. canning
c. artificial ecosystems	d. chemical preservation

15J

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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The Designed World

Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.

E. Energy is the capacity to do work.

64. Some forms of energy are
a. mechanical energy
b. electrical energy
c. chemical energy
d. All of the above

64a. When force is used to move an object, this is produced _________.
a. energy b. power
c. heat energy **d. work**
16E

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

F. Energy can be used to do work, using many processes.

65. Gasoline, diesel, and rocket engines are sample of
a. solar powered motor
b. external combustion engines
c. internal combustion engines
d. battery powered motor

65a. It can be used to powers our cars, trains, and planes and lights our homes, stores, and offices.
a. work b. muscle
c. energy d. power
16F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done.

66. What measurement is use to determine how quickly the work is done?

a. horsepower	b. distance
c. power	**d. rate**

66a. Is a measure that is generally expressed in wattage or horsepower?

a. distance	b. energy
c. volume	**d. power**

16G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

H. Power systems are used to drive and provide propulsion to other technological products and systems.

67. By collecting solar energy, solar panels can generate

a. electricity	b. solar energy
c. nuclear energy	d. mechanical energy

67a. Chances wind energy into electrical energy

a. wind generator	b. power system
c. engine	d. battery

16H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

I. Much of the energy used in our environment is not used efficiently.

68. Which of the following is not a way to conserve more energy?
a. carpooling b. insulation
c. turn off lights **d. leaving the lights on**

68a. The act of making better use of energy is called _________.
a. polluting b. recycling
c. technology **d. conservation**
16I

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________

Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

H. Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human.

69. The communication mode used when you play a video game is
a. people to machine
b. machine to people
c. machine to machine
d. people to people

69a. Talking to your friends at school is an example of __________________ communication.
a. people to people
b. machine to people
c. machine to machine
d. people to machine
17H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________

I. Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination.

70. The radio in your car is a __________ and the radio station is the _________.
a. message, messenger
b. receiver, transmitter
c. cd player, cd
d. encoder, decoder

70a. Which of the following devices change a signal from an analog to digital
a. video camera
b. motherboard
c. hardrive
d. keys on the keyboard
17I

Clarity and Readability
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

71. The code in which information on the World Wide Web is written
a. URL
b. browser
c. search engine
d. HTML

71a. The following technologies help handicapped people communicate except
a. audiotapes
b. internet
c. closed-captured television
d. hand signals
17J

Clarity and Readability
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item Difficulty
Rating
High 10 9 8 | Medium 7 6 5 4 | Low 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

72. The technique used to make drawing that describe the exact size, shape, and structure of objects is called

a. drafting b. sketching
c. painting d. drawing

72a. The way we communicate ideas in a technological system is by
a. speaking and writing
b. drawing, photos and symbols
c. by looking in the mirror
d. a and b
17K

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.

F. Transporting people and goods involves a combination of individuals and vehicles.

73. The space shuttle is a ____________________ transportation vehicle.

a. land and water b. land and space
c. air and space d. air and land

73a. Transporting people and goods involves a combination of

a. individual's b. politics
c. vehicles **d. a and c**
18F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively.

74. Reason maglev train is quiet
a. travels at slow speed
b. cars are well design
c. the cars don't touch the tracks
d. it is well aerodynamically designed

74a. Structure, propulsion, suspension, guidance, and control work together to make a
a. space transportation system
b. air transportation system
c. vehicle system
d. intermodal transportation system
18G

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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____

H. Governmental regulations often influence the design and operation of transportation systems.

75. The Federal Aviation administration regulates this except,
a. issue licenses to pilots
b. set land speed limits
c. air space
d. air safety

75a. This often influences the design and operation of transportation
a. the public
b. Governmental regulation
c. the manufacture
d. the company
18H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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I. Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently.

76. Transportation that moves many people at once and available to the general public is called
a. automobiles
b. mass transportation
c. space shuttle
d. vessel

76a. Are necessary for the entire transportation system to operate efficiently
a. routing, scheduling, loading
b. receiving, moving, unloading
c. delivering, storing, communicating
d. a, b and c
18I

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

F. Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them.

77. The last step in metal casting is
a. preparing the material
b. introduce and solidify the material
c. extracting the part
d. prepare the mold

77a. Manufacturing process that cut, grind, or crush a material to create a form is called ___ ________.
a. casting
b. manufacturing
c. Mechanical processing
d. none
19F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Manufactured goods may be classified as durable and non-durable.

78. Which products is an example of non-durable goods

a. hammers b. bicycles
c. television **d. calendars**

78a. Manufacturing products that can be used over a relatively long period of time are called

_______.

a. non-durables goods
b. primary processes
c. secondary processes
d. durable goods
19G

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________
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H. The manufacturing process includes the designing, development, making, and servicing of products and systems.

79. All of the following take place in a R & D department except

a. problem are solve through experimentation
b. products are manufactured
c. research on products in the market
d. invention and innovation

79a. The integration of people, procedures, and equipment to produce products efficiently is called a

a. transportation system
b. manufacturing system
c. construction system
d. communication system
19H

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ______________________
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I. Chemical technologies are used to modify or alter chemical substances.

80. Chemical compound needed to make plastic

a. wood	b. salt
c. glass	**d. resin**

80a. Are used to modify or alter chemical substances
a. Chemical technologies
b. Construction technologies
c. Production technologies
d. none
19I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

J. Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining.

81. Materials in their natural state are called
a. raw material
b. processed materials
c. manufacturing materials
d. synthetic materials

81a. Ways that living things, minerals and other elements found in the ground, sea, or air can be removed from the earth include all of the following except
a. harvesting
b. drilling
c. mining
d. experimentation
19J

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

K. Marketing a product involves informing the public about it as well as assisting in its sales and distribution.

82. Word of mouth advertising uses ____________ to distribute information.
a. Ads in magazines
b. radio and television
c. mail and billboards
d. individuals

82a. Marketing a product involves ________ _______ and _________________.
a. informing the public and internet
b. informing the public and ordering
c. selling and distribution
d. selling and building
19K

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

83. Rules used to control how structures are built are called
a. safety rules b. builders
c. building codes d. standards

83a. The selection of design for structures is based on the following factor except:
a. building laws and codes
b. style and cost
c. convenience and color
d. contractor
20F

Clarity and Readability
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item Difficulty
Rating
High Medium Low
10 9 8 7 6 5 4 3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

G. Structures rest on a foundation.

84. Part of the house that rest on the ground is called a

a. building site
b. footings
c. foundation
d. subfloor

84a. Foundations can be made from this material except

a. concrete
b. steel
c. water
d. wooden poles

20G

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

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H. Some structures are temporary, while others are permanent.

85. Construction material made of cement, sand, stones, and water, used for columns, foundations, walls, and floor is called

a. concrete
b. composite
c. resin
d. fiber

85a. Building materials used for the interior and exterior of a house are:

a. brick, rock, stone, and brink veneer
b. siding, log, wood, and plywood
c. metal, wall board, concrete, and glass
d. all of the above

20H

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________

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I. Buildings generally contain a variety of subsystems.

86. A good example of utility subsystems is
a. electricity, natural gas, and water
b. natural gas, water, and insulation
c. electricity, water, and reinforced foundation
d. none

86a. Most building subsystems are referred to as ______________.

a. utilities b. appliances
c. buildings d. groups
20I

Clarity and Readability
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Relationship of the question to the STL grade 6-8 benchmarks and appropriateness of the item for a grade 6-8 learner in technology education
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item Difficulty
Rating

High	Medium	Low
10 9 8	7 6 5 4	3 2 1 0

Item needs revision YES NO
Proposed Revision ____________________
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86 Question Items Test Bank

1. A Rapid Prototyping machine uses information from drawings to create
a. CAD drawings
b. modeling software
c. three dimensional objects
d. lasers

2. It is created to meet human needs and wants.
a. Engineering
b. Math
c. Technology
d. Science

3. The modification of an existing product or system is known as
a. innovation
b. new technology
c. manufacturing
d. process

4. When you conduct a survey to find out how well a product is going to sell it is called
a. quality control
b. market research
c. scientific management
d. production

5. When a system cannot measure or control its output it is known as
a. process
b. open-loop system
c. normal flow
d. closed-loop system

6. Your computer, software, firmware, monitor, keyboard, and speakers are examples of parts of a
a. group
b. system
c. motor
d. team

7. This system requires no human intervention; it is called a/an
a. open-loop
b. system
c. feedback
d. close-loop

8. Which device does not control other devices?
a. speakers
b. a light switch
c. a garage opener
d. a remote control

9. Name two things that may happen if a part malfunctions in a product
a. It may affect the function and quality of the product.
b. You may need to replace it and spend money.
c. You may need to contact the store and the company.
d. You may affect the function and may need to replace it.

10. A restriction or requirement identified during the design phase of a product is called a/an
a. run of time
b. problem arises
c. constraint
d. design problem

11. In the decision process, recognizing the needs among the competing factors is called a
a. want b. solution
c. need **d. trade-off**

12. The method of printing that utilizes an open screen of silk, nylon, or metal mesh is called
a. ink-jet printing b. flexography
c. gravure printing **d. serigraphy**

13. The reason you should service and maintain your car is because ___________.
a. you don't want any future engine problems b. you want to save gas
c. you hear a funny noise from the engine d. you want to see the new cars

14. This device contains a microprocessor that allows your TV to change channels
a. your remote control b. your brain
c. your car keys d. the door bell

15. A system used to accurately establish a receiver's position is called a
a. compass **b. global position system (GPS)**
c. map d. globe

16. The compact disc is an evolution of
a. the telegraph b. the printer
c. the television set **d. Edison's cylindrical record**

17. Recycled cooking oil can be used in this method of transportation
a. a solar-generated electric car b. a train
c. a bio-diesel d. an airplane

18. Science explains how things work, while ___________ makes things happen
a. Technology b. History
c. Engineering d. Mathematics'

19. The following are samples of negative impacts of technology except ________.
a. air pollution b. soil erosion
c. recycling d. water pollution

20. One of the problems that technology faces in schools is because
a. **it's not available for everyone** b. it's free
c. it's expensive d. it's not improving the world

21. What title would be more descriptive of someone who woks with technology?
a. scientists b. mechanics
c. technicians d. artisans

22. To recycle means
a. to reduce pollution
b. to use again
c. to carpool
d. to send waste to landfills

23. How can technologies be used to repair damage caused by nature disasters?
a. to find new ways of reducing waste production
b. to conserve more energy
c. to reduce the use of nonrenewable resources
d. all of the above

24. Which is an advantage of a fuel cell in the environment?
a. they are cheap
b. they are practical
c. they don't pollute
d. they are easy to find

25. A method used to help crops get the right amount of water is called
a. fertilization
b. irrigation
c. monoculture farming
d. hybrid

26. The Information Age is best known for
a. the replacement of iron materials
b. the rebirth on the arts and humanities
c. manufacturing, transportation, communication, and construction
d. invention, processing, storage, and exchange of data

27. What is the name of the new transportation concept that uses both gasoline engine and an electric motor
a. hybrid cars
b. solar cars
c. locomotives
d. airplanes

28. When selecting a cellular phone, people often look for the following:
a. a small size
b. its ease of use
c. a bargain
d. all of the above

29. They start and build their work based on the earlier work and discoveries of others
a. Engineers
b. Scientists
c. Technicians
d. All of the above

30. What is the purpose of a memory card in a digital camera?
a. to take the picture
b. to store images or pictures
c. to charge the camera
d. to print the image

31. A ruler is effective in measuring the following except:
a. length
b. thickness
c. temperature
d. width

32. The profession that involves designing products or structures

a. Engineering b. Science
c. Mechanics d. Medicine

33. A software that can be used to produce a flyer or magazine is called

a. printing b. video production
c. desktop publishing d. graphic design

34. The first working design is called a

a. picture **b. prototype**
c. sketch d. model

35. In the first step of the design process, what items should be identified?

a. the needs and wants desired b. the designs and the needs
c. the problems and wants d. the solutions and the problems

36. Which involves a set of steps with different sequences that are repeated as needed?

a. criteria b. evaluating the solution
c. brainstorming **d. defining problem**

37. When a group of individuals are asked to give or provide as many solutions as possible in a short time, this is called

a. conditioning b. evaluating
c. modeling **d. brainstorming**

38. A manufacturing method that changes the shape of a material is called

a. finishing **b. forming**
c. conditioning d. combining

39. The name of the procedure used to identify the cause of the malfunction in a technological system is:

a. trouble-shooting b. researching
c. experimenting d. processing

40. The evolution of the bicycle to the motorcycle is an example of a/an

a. invention b. idea
c. innovation d. discovery

41. A way to discover new knowledge is through

a. theory b. testing
c. experimentation d. defining the problem

42. When using the engineering design process ___________ uses mathematics skills to help us understand how the design may function.

a. the prototype b. building the part
c. trial and error **d. mathematical modeling and analysis**

43. Constraints are the limitations for the design while the criteria are
a. a clear definition of the problem
b. problems dealing with society
c. elements of the problem needing to be solved
d. problems that can affect individuals

44. Examples of two-dimensional and three dimensional forms are:
a. sketches
b. drawings
c. computer-assisted designs
d. all of the above

45. The advantages of having a rapid prototype machine is that
a. the product is made of metal
b. it is the final replica of the product
c. it is less expensive than casting
d. it creates a prototype or model sample

46. When making a product, this method of documenting the solution should be used
a. cameras (photography)
b. design portfolios (documenting via a portfolio)
c. journals (journaling)
d. all of the above

47. When installing a new computer, you should use the following item
a. an almanac
b. your computer manual
c. your TV manual
d. the library

48. When installing or repairing electronic equipment, the most important thing to follow is
a. the recommended instructions
b. the manual
c. the road
d. the safety procedures

49. This device is used to diagnose and service a car
a. a computer
b. technicians
c. tools
d. manuals

50. A technician should have this skill in order to repair equipment
a. be able to understand the operation and maintenance
b. be able to correct the problem in minutes
c. be able to read the manual
d. none of the above

51. When a weather satellite collects raw facts and figures for a report, it is called
a. the scientific method
b. research process
c. **data**
d. a conclusion

52. Data collection from a damaged building can help builders
a. collect data
b. conduct surveys
c. build models
d. design new and safe buildings

53. What is a particular impact of developing a flash light that doesn't require batteries?
a. more reliability
b. it's better for the environment
c. a greater expense
d. it's better technology

54. Engineers do this to existing products and systems to determine if they are useful or not
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent

55. In the field of health and medicine, technology helps to ________________.
a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above

56. Sanitation processes used in the disposal of medical products help control _________.
a. people
b. treatment
c. disease
d. medicine

57. A vaccination that allows the body to resist disease is called
a. immunization
b. sterilization
c. food additives
d. smallpox

58. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

59. A chemical that restores nutrients in the soil?
a. irrigation
b. monoculture
c. fertilizer
d. hydrid

60. A method used by farmers to water their crops is
a. bioremediation
b. irrigation technology
c. dehydration
d. monoculture

61. The biology of plant growth in agriculture comes from this area of science:
a. plant science
b. chemical science
c. technology
d. physical science

62. ______________ are human-made systems reproducing some parts of the natural environment.
a. Dehydrations
b. Cannings
c. Artificial ecosystems
d. Chemical preservations

63. Preserving food by removing its moisture is called
a. dehydration
b. canning
c. artificial ecosystems
d. chemical preservation

64. Some form(s) of energy are
a. mechanical energy
b. electrical energy
c. chemical energy
d. All of the above

65. Gasoline, diesel, and rocket engines are samples of
a. solar powered motors
b. external combustion engines
c. internal combustion engines
d. battery powered motors

66. What measurement is used to determine how quickly the work is done?
a. horsepower
b. distance
c. power
d. rate

67. By collecting solar energy, solar panels can generate
a. electricity
b. solar energy
c. nuclear energy
d. mechanical energy

68. The act of making better use of energy is called
a. pollution
b. recycling
c. technology
d. conservation

69. The communication mode used when you play a video game is
a. people to machine
b. machine to people
c. machine to machine
d. people to people

70. The radio in your car is a(n) __________ and the radio station is the _________.
a. message, messenger
b. receiver, transmitter
c. cd player, cd
d. encoder, decoder

71. The code in which information on the World Wide Web is written
a. URL
b. browser
c. search engine
d. HTML

72. The technique used to make drawings that describes the exact size, shape, and structure of objects is called a
a. drawing
b. sketching
c. painting
d. drafting

73. The space shuttle is a transportation vehicle that is to be used in
a. land and water
b. land and space
c. air and space
d. air and land

74. The reason a maglev train is quiet is because
a. it travels at slow speeds
b. the cars are well designed
c. the cars don't touch the tracks
d. it has a good aerodynamically design

75. The Federal Aviation administration regulates all of these except __________.

a. issuing licenses to pilots
b. set land speed limits
c. air space
d. air safety

76. Transportation that moves more than six people at once and is available to the general public is called

a. automobiles
b. mass transportation
c. space shuttle
d. vessel

77. The manufacturing process that cuts, grinds, or crushes a material to create a form is called _.

a. casting
b. manufacturing
c. Mechanical processing
d. none

78. Which products are examples of non-durable goods?

a. hammers
b. bicycles
c. television
d. calendars

79. All of the following take place in a research and developing department except

a. problems solved through experimentation
b. the manufacturing of products
c. market research of products
d. invention and innovation

80. _________ are used to modify or alter chemical substances

a. Chemical technologies
b. Construction technologies
c. Production technologies
d. none

81. Materials in their natural state are called

a. raw materials
b. processed materials
c. manufacturing materials
d. synthetic materials

82. Marketing a product involves ______________ and ______________.

a. informing the public and internet
b. informing the public and ordering
c. selling and distributing
d. selling and building

83. Rules used to control how structures are built are called

a. safety rules
b. builders
c. building codes
d. standards

84. The part of the house that rests on the ground is called a

a. building site
b. footings
c. foundation
d. subfloor

85. A construction material composed of cement, sand, stone, and water that is utilized for columns, foundations, walls, and floors is called

a. concrete b. composite
c. resin d. fiber

86. Good examples of utility subsystems are:

a. electricity, natural gas, and water b. natural gas, water, and insulation
c. electricity, water, and reinforced foundation d. none

FORM A

Name/ID ________________ Male _____ Female ___ Period ___

INSTRUCTIONS: Read each question carefully and choose the ONE best answer. Circle and record each answer on the line provided. You may work on the multiple-choice questions in any order that you choose.

7716G

_______1. The manufacturing process that cuts, grinds, or crushes a material to create a form is called

a. casting
b. manufacturing
c. Mechanical processing
d. none

4812J

______2. When installing or repairing electronic equipment, the most important thing to follow is

a. the recommended instructions
b. the manual
c. the road
d. the safety procedures

5213G

______3. Data collection from a damaged building can help builders

a. collect data
b. conduct surveys
c. build models
d. design new and safe buildings

8219K

______4. Marketing a product involves _______________ and _____________.

a. informing the public and internet
b. informing the public and ordering
c. selling and distributing
d. selling and building

7117J

______5. The code in which information on the World Wide Web is written

a. URL
b. browser
c. search engine
d. HTML

0101F

______6. A Rapid Prototyping machine uses information from drawings to create

a. CAD drawings
b. modeling software
c. three dimensional objects
d. lasers

5514H

______7. In the field of health and medicine, technology helps to _____________.

a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above

4511K
______8. The advantages of having a rapid prototype machine is that
a. the product is made of metal
b. it is the final replica of the product
c. it is less expensive than casting
d. it creates a prototype or model sample

5614H
______9. Sanitation processes used in the disposal of medical products help control ____.
a. people
b. treatment
c. disease
d. medicine

2506D
______10. A method used to help crops get the right amount of water is called
a. fertilization
b. irrigation
c. monoculture farming
d. hybrid

6816I
______11. The act of making better use of energy is called
a. pollution
b. recycling
c. technology
d. conservation

3007E
______12. What is the purpose of a memory card in a digital camera?
a. to take the picture
b. to store images or pictures
c. to charge the camera
d. to print the image

0802P
______13. Which device does not control other devices?
a. speakers
b. a light switch
c. a garage opener
d. a remote control

4110H
______14. A way to discover new knowledge is through
a. theory
b. testing
c. experimentation
d. defining the problem

5412I
______15. Engineers do this to existing products and systems to determine if they are useful or not
a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent

3609G
______16. Which involves a set of steps with different sequences that are repeated as needed?
a. criteria
b. evaluating the solution
c. brainstorming
d. defining problem

5012K
______17. A technician should have this skill in order to repair equipment
a. be able to understand the operation and maintenance
b. be able to correct the problem in minutes
c. be able to read the manual
d. none of the above

8019I
______18. _________ are used to modify or alter chemical substances
a. Chemical technologies b. Construction technologies
c. Production technologies d. none

5914G
______19. A chemical that restores nutrients in the soil?
a. irrigation b. monoculture
c. fertilizer d. hydrid

5814J
______20. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant b. telemedicine
c. genetic engineering d. bionics

4211H
______21. When using the engineering design process ___________ uses mathematics skills to help us understand how the design may function.
a. the prototype b. building the part
c. trial and error **d. mathematical modeling and analysis**

0902Q
______22. Name two things that may happen if a part malfunctions in a product
a. It may affect the function and quality of the product.
b. You may need to replace it and spend money.
c. You may need to contact the store and the company.
d. You may affect the function and may need to replace it.

1202T
______23. The method of printing that utilizes an open screen of silk, nylon, or metal mesh is called
a. ink-jet printing b. flexography
c. gravure printing **d. serigraphy**

8420G
______24. The part of the house that rests on the ground is called a
a. building site b. footings
c. foundation d. subfloor

6516F

______25. Gasoline, diesel, and rocket engines are samples of

a. solar powered motors
b. external combustion engines
c. internal combustion engines
d. battery powered motors

1703F

______26. Recycled cooking oil can be used in this method of transportation

a. a solar-generated electric car
b. a train
c. a bio-diesel
d. an airplane

7318F

______27. The space shuttle is a transportation vehicle that is to be used in

a. land and water
b. land and space
c. air and space
d. air and land

4010G

______28. The evolution of the bicycle to the motorcycle is an example of a/an

a. invention
b. idea
c. innovation
d. discovery

7217K

______29. The technique used to make drawings that describes the exact size, shape, and structure of objects is called a

a. drawing
b. sketching
c. painting
d. drafting

6416E

______30. Some form(s) of energy are

a. mechanical energy
b. electrical energy
c. chemical energy
d. All of the above

8620I

______31. Good examples of utility subsystems are:

a. electricity, natural gas, and water
b. natural gas, water, and insulation
c. electricity, water, and reinforced foundation
d. none

0201G

______32. It is created to meet human needs and wants.

a. Engineering
b. Math
c. Technology
d. Science

3107E

______32. A ruler is effective in measuring the following except:

a. length
b. thickness
c. temperature
d. width

7819H

______33. Which products are examples of non-durable goods?

a. hammers
b. bicycles
c. television
d. calendars

3910F

______34. The name of the procedure used to identify the cause of the malfunction in a technological system is:

a. trouble-shooting
b. researching
c. experimenting
d. processing

1603E

______35. The compact disc is an evolution of

a. the telegraph
b. the printer
c. the television set
d. Edison's cylindrical record

FORM B

Name/ID __________________ Male _____ Female ___ Period ___

INSTRUCTIONS: Read each question carefully and choose the ONE best answer. Circle and record each answer on the line provided. You may work on the multiple-choice questions in any order that you choose.

8019I
______ 1. _________ are used to modify or alter chemical substances
a. Chemical technologies b. Construction technologies
c. Production technologies d. none

7318F
______ 2. The space shuttle is a transportation vehicle that is to be used in
a. land and water b. land and space
c. air and space d. air and land

1102S
______ 3. In the decision process, recognizing the needs among the competing factors is called a
a. want b. solution
c. need **d. trade-off**

1603E
______ 4. The compact disc is an evolution of
a. the telegraph b. the printer
c. the television set **d. Edison's cylindrical record**

7017I
______ 5. The radio in your car is a(n) __________ and the radio station is the _________.
a. message, messenger **b. receiver, transmitter**
c. cd player, cd d. encoder, decoder

8520H
______ 6. A construction material composed of cement, sand, stone, and water that is utilized for columns, foundations, walls, and floors is called
a. concrete b. composite
c. resin d. fiber

4812I
______ 7. When installing or repairing electronic equipment, the most important thing to follow is
a. the recommended instructions b. the manual
c. the road **d. the safety procedures**

5514G
______ 8. In the field of health and medicine, technology helps to ____________
______.

a. treat illnesses
b. prevent illness
c. diagnose diseases
d. all of the above

5814J

______ 9. A method that modifies the generic material in DNA in order to cure a disease?
a. electronic transplant
b. telemedicine
c. genetic engineering
d. bionics

7618I
______ 10. Transportation that moves more than six people at once and is available to the general public is called
a. automobiles
b. mass transportation
c. space shuttle
d. vessel

6115H
______ 11. The biology of plant growth in agriculture comes from this area of science:
a. plant science
b. chemical science
c. technology
d. physical science

2305E
______ 12. How can technologies be used to repair damage caused by nature disasters?
a. to find new ways of reducing waste production
b. to conserve more energy
c. to reduce the use of nonrenewable resources
d. all of the above

3508G
______ 13. In the first step of the design process, what items should be identified?
a. the needs and wants desired
b. the designs and the needs
c. the problems and wants
d. the solutions and the problems

5313H
______ 14. What is a particular impact of developing a flash light that doesn't require batteries?
a. more reliability
b. it's better for the environment
c. a greater expense
d. it's better technology

2004F
______ 15. One of the problems that technology faces in schools is because
a. **it's not available for everyone**
b. it's free
c. it's expensive
d. it's not improving the world

5915F

_______ 16. A chemical that restores nutrients in the soil?

a. irrigation
b. monoculture
c. fertilizer
d. hydrid

0902Q

_______ 17. Name two things that may happen if a part malfunctions in a product

a. It may affect the function and quality of the product.
b. You may need to replace it and spend money.
c. You may need to contact the store and the company.
d. You may affect the function and may need to replace it.

3207F

_______ 18. The profession that involves designing products or structures

a. Engineering
b. Science
c. Mechanics
d. Medicine

0802P

_______ 19. Which device does not control other devices?

a. speakers
b. a light switch
c. a garage opener
d. a remote control

8219K

_______ 20. Marketing a product involves ______________ and ______________.

a. informing the public and internet
b. informing the public and ordering
c. selling and distributing
d. selling and building

4611L

_______ 21. When making a product, this method of documenting the solution should be used

a. cameras (photography)
b. design portfolios (documenting via a portfolio)
c. journals (journaling)
d. all of the above

4511K

_______ 22. The advantages of having a rapid prototype machine is that

a. the product is made of metal
b. it is the final replica of the product
c. it is less expensive than casting
d. it creates a prototype or model sample

7819G

_______ 23. Which products are examples of non-durable goods?

a. hammers
b. bicycles
c. television
d. calendars

4110H

______ 24. A way to discover new knowledge is through

a. theory
b. testing
c. experimentation
d. defining the problem

8320F

______ 25. Rules used to control how structures are built are called

a. safety rules
b. builders
c. building codes
d. standards

1503D

______ 26. A system used to accurately establish a receiver's position is called a

a. compass
b. global position system (GPS)
c. map
d. globe

5012K

______ 27. A technician should have this skill in order to repair equipment

a. be able to understand the operation and maintenance
b. be able to correct the problem in minutes
c. be able to read the manual
d. none of the above

7418G

______ 28. The reason a maglev train is quiet is because

a. it travels at slow speeds
b. the cars are well designed
c. the cars don't touch the tracks
d. it has a good aerodynamic design

0401I

______ 29. When you conduct a survey to find out how well a product is going to sell it is called

a. quality control
b. market research
c. scientific management
d. production

4211H

______ 30. When using the engineering design process ___________ uses mathematics skills to help us understand how the design may function.

a. the prototype
b. building the part
c. trial and error
d. mathematical modeling and analysis

6716E

______ 31. By collecting solar energy, solar panels can generate

a. electricity
b. solar energy
c. nuclear energy
d. mechanical energy

0201G

_______ 32. It is created to meet human needs and wants.

a. Engineering b. Math

c. Technology d. Science

4010G

_______ 33. The evolution of the bicycle to the motorcycle is an example of a/an

a. invention b. idea

c. innovation d. discovery

34. A Rapid Prototyping machine uses information from drawings to create

a. CAD drawings b. modeling software

c. three dimensional objects d. lasers

35. When a weather satellite collects raw facts and figures for a report, it is called

a. the scientific method b. research process

c. **data** d. a conclusion

FORM C

Name/ID ________________ Male _____ Female ___ Period ___

INSTRUCTIONS: Read each question carefully and choose the ONE best answer. Circle and record each answer on the line provided. You may work on the multiple-choice questions in any order that you choose.

8320F

______ 1. Rules used to control how structures are built are called

a. safety rules
b. builders
c. building codes
d. standards

7719F

______ 2. The manufacturing process that cuts, grinds, or crushes a material to create a form is called _.

a. casting
b. manufacturing
c. Mechanical processing
d. none

7318F

______ 3. The space shuttle is a transportation vehicle that is to be used in

a. land and water
b. land and space
c. air and space
d. air and land

6516F

______ 4. Gasoline, diesel, and rocket engines are samples of

a. solar powered motors
b. external combustion engines
c. internal combustion engines
d. battery powered motors

2907C

______ 5. They start and build their work based on the earlier work and discoveries of others

a. Engineers
b. Scientists
c. Technicians
d. All of the above

1202T

______ 6. The method of printing that utilizes an open screen of silk, nylon, or metal mesh is called

a. ink-jet printing
b. flexography
c. gravure printing
d. serigraphy

4211H

______ 7. When using the engineering design process __________ uses mathematics skills to help us understand how the design may function.

a. the prototype b. building the part

c. trial and error **d. mathematical modeling and analysis**

6917H

______ 8. The communication mode used when you play a video game is

a. people to machine b. machine to people

c. machine to machine d. people to people

1101S

______ 9. In the decision process, recognizing the needs among the competing factors is called a

a. want b. solution

c. need **d. trade-off**

3910F

______ 10. The name of the procedure used to identify the cause of the malfunction in a technological system is:

a. trouble-shooting b. researching

c. experimenting d. processing

6015G

______ 11. A method used by farmers to water their crops is

a. bioremediation b. irrigation technology

c. dehydration **d. monoculture**

3408F

______ 12. The first working design is called a

a. picture b. prototype

c. sketch **d. model**

4912J

______ 13. This device is used to diagnose and service a car

a. a computer b. technicians

c. tools d. manuals

5714I

______ 14. A vaccination that allows the body to resist disease is called

a. immunization b. sterilization

c. food additives d. smallpox

0902Q

______ 15. Name two things that may happen if a part malfunctions in a product

a. It may affect the function and quality of the product.

b. You may need to replace it and spend money.

c. You may need to contact the store and the company.

d. You may affect the function and may need to replace it.

3809H

______ 16. A manufacturing method that changes the shape of a material is called

a. finishing
b. forming
c. conditioning
d. combining

5113F

______ 17. When a weather satellite collects raw facts and figures for a report, it is called

a. the scientific method
b. research process
c. data
d. a conclusion

1603E

______ 18. The compact disc is an evolution of

a. the telegraph
b. the printer
c. the television set
d. Edison's cylindrical record

5413I

______ 19. Engineers do this to existing products and systems to determine if they are useful or not

a. evaluate and assess
b. analyze and build
c. find and destroy
d. evaluate and invent

0801P

______ 20. Which device does not control other devices?

a. speakers
b. a light switch
c. a garage opener
d. a remote control

3308E

______ 21. A software that can be used to produce a flyer or magazine is called

a. printing
b. video production
c. desktop publishing
d. graphic design

5614H

______ 22. Sanitation processes used in the disposal of medical products help control

__________.

a. people
b. treatment
c. disease
d. medicine

2506D

_______ 23. A method used to help crops get the right amount of water is called
a. fertilization **b. irrigation**
c. monoculture farming d. hybrid

5213G

_______ 24. Data collection from a damaged building can help builders
a. collect data b. conduct surveys
c. build models **d. design new and safe buildings**

3007D

_______ 25. What is the purpose of a memory card in a digital camera?
a. to take the picture **b. to store images or pictures**
c. to charge the camera d. to print the image

4712H

_______ 26. When installing a new computer, you should use the following item
a. an almanac **b. your computer manual**
c. your TV manual d. the library

8420G

_______ 27. The part of the house that rests on the ground is called a
a. building site b. footings
c. foundation d. subfloor

5313H

_______ 28. What is a particular impact of developing a flash light that doesn't require batteries?
a. more reliability b. it's better for the environment
c. a greater expense d. it's better technology

5514G

_______ 29. In the field of health and medicine, technology helps to _________________ _______.
a. treat illnesses b. prevent illness
c. diagnose diseases **d. all of the above**

4010G

_______ 30. The evolution of the bicycle to the motorcycle is an example of a/an
a. invention b. idea
c. innovation d. discovery

5012K

______ 31. A technician should have this skill in order to repair equipment

a. be able to understand the operation and maintenance

b. be able to correct the problem in minutes

c. be able to read the manual

d. none of the above

1301U

______ 32. The reason you should service and maintain your car is because _____.

a. you don't want future engine problems b. you want to save gas

c. you hear a funny noise from the engine d. you want to see new cars

2706F

_______ 33. What is the name of the new transportation concept that uses both gasoline engine and an electric motor?

a. hybrid cars b. solar cars

c. locomotives d. airplanes

3107E

_______ 34. A ruler is effective in measuring the following except:

a. length b. thickness

c. temperature d. width

2104G

_______ 35. What title would be more descriptive of someone who woks with technology?

a. scientists b. mechanics

c. technicians d. artisans