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Implementation of Standards of Technological Literacy

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IMPLEMENTATION OF STANDARDS OF TECHNOLOGICAL LITERACY

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CHAPTER I
INTRODUCTION

Sponsored by the International Technology Education Association, and with the assistance of the National Science Foundation, the National Aeronautical Space Administration and various professionals and educators, the field of Technology Education has developed a set of standards that set minimum guidelines, *Standards for Technological Literacy* (ITEA, 2000), that must be met in order for an individual to be deemed technologically knowledgeable. This concept is similar to standards already in place for Language Arts, Mathematics, Science and Social Studies. In the Commonwealth of Virginia these are know as Standards of Learning (SOL). One of the key differences between the SOL type standards and the *Standards for Technological Literacy* (ITEA, 2000) is that the SOL standards are mandatory, while the *Standards for Technological Literacy* (ITEA, 2000) are voluntary.

The *Standards for Technological Literacy* (ITEA, 2000) were published in March, 2000. At that time technology educators were able to begin implementing them into their programs. How could they do this if they did not know they were available or what was their purpose? One organization, the Virginia Technology Education Association, chose to use its 2001 summer conference to achieve this goal. During that conference attendees were educated on the standards and encouraged to begin their implementation.

After such introduction there is typically a very positive effort and push to evaluate existing programs to determine the current status and develop a plan for implementation. As time passes some programs may have been updated while others may still be in the

process. With this in mind this research project was initiated to determine the level of implementation of the *Standards for Technological Literacy* (ITEA, 2000) in the programs of those individuals who attended the 2001 Virginia Technology Education Association summer conference.

STATEMENT OF THE PROBLEM

The purpose of this study was to determine the level of implementation of the *Standards for Technological Literacy* (ITEA, 2000) as outlined by the International Technology Education Association for those attendees of the 2001Virginia Technology Education Association summer conference.

RESEARCH GOALS

This descriptive research was driven by the following questions:

1. What is the level of overall implementation of the *Standards for Technological Literacy?*
2. What is the level of implementation for each of the *Standards for Technological Literacy?*
3. In what time frame do respondents expect their programs will have the *Standards for Technological Literacy* fully implemented?
4. Is there formal assessment supporting the *Standards for Technological Literacy?*

BACKGROUND AND SIGNIFICANCE

Technology education, like technology, is constantly evolving. Although it finds its roots in traditional industrial arts, hands-on programs, it now encompasses a much greater field of learning. Through the use of a survey conducted by the Gallup Organization it was found that the American public felt that technological literacy was important for individuals at all levels. Almost totally, they felt technology should be taught in the schools' curriculum (Rose & Dugger, 2002). The International Technology Education Association published its document, *Rationale and Structure* (ITEA, 1996), which in turn provided the basis for the standards that were to come. Based on the *Rationale and Structure* document a team was assembled to develop these standards. With input from hundreds of educators and other professionals the *Standards for Technological Literacy* were finalized and published in 2000 (ITEA, 2000).

The *Standards for Technological Literacy* (ITEA, 2000) alone accomplish nothing; they must be incorporated into school curricula in order for their potential to be realized. Through professional development activities one organization, the Virginia Technology Education Association, provided training to its members during their 2001 summer conference. With this newly gained knowledge these individuals were encouraged to begin the implementation of the *Standards for Technological Literacy* (ITEA, 2000). Have the attendees of the conference implemented the standards? Do they have a formal way of assessing the performance of students based on these educational outcomes?

Although these standards are not mandatory, they do provide a set of benchmarks for each technological literacy standard. This helps to ensure that programs' outcomes are more consistent than if no standards were available. Having the guidelines available does not bind the ability of the individual educators or programs to one set way of educating the students, instead the benchmarks set a framework to follow when creating curriculum (ITEA, 2000). Educators are free to use their creativity to meet learning and instructional needs. The use of the *Standards for Technological Literacy* (ITEA, 2000) further legitimizes the field of technology education. Even though these standards are voluntary, it should be realized that in the event that the majority of educators implement these standards, they will become the norm for programs to be evaluated.

Knowing that the *Standards for Technological Literacy* (ITEA, 2000) are available and being recommended for implementation into technology education programs is just a step in the overall process of total implementation of the *Standards*. This study's significance is that it will quantify the study's population level of implementing the *Standards* into their programs. During the literature review for this research none of the reviewed information revealed actual levels of implementation of the *Standards*. Not only will the study determine where implementation is currently being achieved, it will also attain a projected implementation schedule for implementation by the study population.

LIMITATIONS

This study was limited by the following parameters:

a. Not all respondents will have or use the same objectivity or measuring scale to determine if they have implemented the standards.
b. Only those individuals who are members of the Virginia Technology Education Association (VTEA) and attended the 2001 summer conference at Virginia Polytechnic Institute and State University will be surveyed.
c. The target audience for the survey was middle school and secondary school technology educators.
d. The survey period was from October 27, 2003, to November 14, 2003.
e. Not all attendees of the conference continue to teach Technology Education and therefore do not have a need to implement the *Standards for Technological Literacy* (ITEA, 2000).

ASSUMPTIONS

This study assumes the following parameters:

a. All attendees of the conference teach in a school setting.
b. All attendees were aware of the *Standards for Technological Literacy* (ITEA, 2000).
c. All attendees have received little help since the conference to implement the *Standards*.
d. All attendees used the Virginia Technology Education Association 2001 summer conference as professional development to update their knowledge in the field and their technology education programs to reflect the *Standards for Technological Literacy* (ITEA, 2000).

PROCEDURES

A survey containing four questions concerning implementation of ITEA's S*tandards for Technologic Literacy* (ITEA, 2000) was sent to all known attendees of the Virginia Technology Education Association's 2001 summer conference held at Virginia Polytechnic Institute and State University. The completed surveys were returned to Old Dominion University's Department of Occupational Technical Studies in Norfolk, Virginia. The return of completed surveys from the target population was limited to three weeks from the original mail out date. The information from the completed surveys was analyzed. Based on the data analysis, Summary, Conclusions and Recommendations were assembled.

DEFINITIONS OF TERMS

The following terms are used throughout this research project and have been developed for clarification and common understanding between the reader and the researcher.

International Technology Education Association (ITEA) – Worldwide professional organization devoted to enhancing technology education in schools. It is responsible for publishing the *Standards for Technological Literacy* (ITEA, 2000) and defining their content (ITEA, 2003).

Standard of Learning (SOL) – The Virginia Board of Education approved Standards of Learning in 1995 in the following areas: English, History, Mathematics, and Science. These standards set minimum criteria that should be mastered in order for students to

meet the standards. To this date there are no Standards of Learning required for technology education.

Standards for Technological Literacy – These are a set of twenty standards developed by the ITEA to give guidance when defining the information that students should master in order to be technologically literate. They would be similar to the Virginia Board of Education's SOL, except tailored to technology education. Within this research paper the *Standards for Technological Literacy* (ITEA, 2000) may also be referenced as *Standards* or *STL*.

Virginia Technology Education Association (VTEA) – The Commonwealth of Virginia's professional association for technology educators. This is the organization used for the study's population.

OVERVIEW OF CHAPTERS

In Chapter I the problem of determining the level of implementation of the *Standards for Technologic Literacy* (ITEA, 2000) for attendees of the 2001 VTEA summer conference was introduced. To accomplish this objective type study, a four question survey was mailed with a cover letter to each attendee of the conference. Upon receipt of the completed surveys, summary and conclusion statements were made.

A literature review of the *Standards for Technological Literacy* (ITEA, 2000) and implementation in Virginia will be addressed in Chapter II. Chapter III will review the data collection and analysis methods used in this study. Detailing the findings that

resulted from the data analysis of the survey will the subject of Chapter IV. Based on the findings, Summary, Conclusions and Recommendation will be presented in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

Technology education has broadened in scope from the days of the purely industrial arts curriculum. Through a collaborative educational and industrial effort, a set of a twenty technology standards were developed. These standards are known as the *Standards for Technological Literacy* (ITEA, 2000). Although much work went into the development of the *Standards*, this is only the initial phase of their achievement. Implementation of the *Standards* into current and new programs will require staff and resource commitments at all levels of education. During the implementation of the *Standards*, students and educators will be exposed to new materials, concepts and experiences. Assessing performance will be a key factor in determining if students have achieved content mastery and areas for improvement from an instructional perspective.

STANDARDS FOR TECHNOLOGICAL LITERACY

The *Standards for Technological Literacy* (ITEA, 2000) are relatively new, having only been published since March 2000. They were created through the International Technology Education Association's project, Technology for All Americans (ITEA, 2000). Their publishing followed four years of development and revisions supported by the National Science Foundation (NSF), the National Aeronautic and Space Administration (NASA), the International Technology Education Association (ITEA), and hundreds of educators and other professionals (ITEA, 2003). In addition to these organizations and individuals, several organizations, such as the National Academy of Sciences (NAS), the National Academy of Engineers (NAE) and the Industrial Designers

Society of America (IDSA) served as champions and endorsed the *Standards for Technological Literacy* (ITEA, 2003).

There are twenty specific standards (see Appendix A) that comprise the *Standards for Technological Literacy* (ITEA, 2000). They can be categorized into five main groups which address various concepts: Standards 1-3, The Nature of Technology; Standards 4-7, Technology and Society; Standards 8-10, Design; Standards 11-13, Abilities for a Technological World; and Standards 14-20, The Design World (ITEA, 2000). The *Standards* can also be viewed from the perspective that Standards 1-10 are more cognitive knowledge oriented, while Standards 11-20 are predominantly psychomotor in nature (Reeve, 2001).

Each of the *Standards for Technological Literacy* (ITEA, 2000) has been subdivided into benchmarks for the various grade divisions. These divisions are grades K-2, 3-5, 6-8 and 9-12. The benchmarks define requirements that students should master in order to meet the specific standard for the specified grade level (ITEA, 2000). The benchmarks do not specify how the educators will develop their curricula in order to teach them. This allows for individual teaching preferences based on educator and student needs.

By its very nature, technology is dynamic, future oriented, and cumulative. Since it does not exist in isolation, neither should the way it is taught. The *Standards* should integrate other content areas because of the broad scope of technology education (Ritz, Dugger, & Isreal, 2002). Technology education is not only hands-on oriented, it also requires the

use of language arts, mathematics, and physical and social sciences skills in order to achieve mastery. This multidisciplinary approach requires more effort on the educators' behalf and reinforces the interrelationships between content areas.

IMPLEMENTATION OF THE STANDARDS

After the development and adoption of the *Standards*, implementation becomes the next key step. Districts and schools with technology education programs already in place must plan the transition from existing programs to the standards-based programs. With implementation comes challenges from both curriculum and teacher perspectives. Support, commitment, and accountability are shared at all professional levels. Here is where the programs will excel or die. Many schools have already embraced and begun to implement the *STL* or *STL*-based alternatives into their curricula.

Curriculum for Implementing Standards

Through ITEA's Technology for All Americans Project, the *Standards for Technological Literacy* (ITEA, 2000) were developed to be implemented in all technology curriculums at all levels of education. Providing the *Standards for Technological Literacy* (ITEA, 2000) and associated benchmarks is only the beginning. Technology education teachers must be engaged in leadership capacities during the entire life cycle (development, adoption and implementation) of local, state, or federal standards (ITEA, 2003). Of the many leadership roles taken, the most important responsibility will be to develop and provide in-service and other developmental information and activities that can be made available to those individuals implementing the *Standards* (ITEA, 2003).

Teachers should design and implement curricula that meet their goals and student needs. A curriculum provides the specific details on how the content is to be delivered. This would include the organization, balance, and presentation of the given material (Barnette, 2003). Similar to standards for other subjects, the *Standards for Technological Literacy* (ITEA, 2000) provide benchmarks for learning, but they do not define the actual lessons and activities that teachers will utilize to engage the students.

In order to move toward the implementation of the *STL*, teachers should be designing their programs around the *Standards* (standards-based lessons) as opposed to the activity based lessons (standards-reflective) that are made to fit and merely reflect the *Standards* (Barnette, 2003). This design process could occur whether existing programs are modified or new programs are created. An advantage to including the standards-based lessons in the design process is that standard-based assessments can also be created at that time.

Teachers' Perspective

Change is often a difficult concept to embrace when it requires an individual to deviate from his/her accepted way of addressing a situation. This concept is no different in technology education. From a teacher's perspective it is very easy to continue with the same lessons for a given subject year after year. Now technology educators are faced with a set of voluntary standards to implement into their curriculums.

Schools and programs will differ in their approach to the dilemma, but there are ways to ease the transition to the *Standards* if that is the route of progress desired by the system and educators. Obtaining and familiarizing themselves with the *Standards* is the first step in the transition. While reviewing the *Standards*, a primary focus should be, "What students should know and be able to do" (Summer, 2001, p. 38).

The *Standards* and the desired student objectives are available, but how should they be implemented? Trying to change an entire curriculum or subject teaching plan is an ominous task. It is conceivable that much of the current documentation could be used and only modifications would be required. However, one should realize that new lessons, activities and assessments will still need to be developed. To ease the stress on those individuals responsible for the change, an incremental approach would be beneficial. The use of goals, development and implementation timelines, and feedback are essential for continual progress.

Implementation into State Programs

Many states have begun the transition to *STL*-based programs. An article published on the subject, *Implementing the Standards: A State Solution to a National Imperative* (Mino, Kane, & Novak, 2001), addresses this topic directly. According to policy presented by President Bush's 107th Congress, there was a call for an increase in technological literacy and that it be considered a "National Public Policy Priority" (Mino, Kane, & Novak, 2001). Implementation must begin immediately if students are going to be able to "manage, use, understand, and assess technology" (Mino, Kane, & Novak,

2001, p. 30). To do this in Connecticut, a group of technology education leaders (teachers, supervisors, administrators and a curriculum consultant) were solicited to develop a set of standards. In March 1998, the state adopted technology standards for K-12 that the group developed. The *STL* played a pivotal role in assisting with Connecticut's standards development. Due to dynamic interests, growing content, and other option developments a high school curriculum was difficult. The use of the *STL* as a reference document made the situation manageable and surmountable.

Once completed, the Connecticut Department of Education wanted to disseminate the new information to all of its schools and have it available for other educators. To do this, they posted their work on the World Wide Web (Mino, Kane, & Novak, 2001, p. 32). When completed, this information sharing would be beneficial to programs across the state and to any other technology educator.

In Whiting's article, *Encouraging Technological Literacy in the Richmond City Schools* (Whiting, 2002), she detailed how the *Standards for Technological Literacy* (ITEA, 2000) have helped to legitimize teaching technology at the elementary school level. The Commonwealth of Virginia already adhered to Standards of Learning (SOL) for core subjects and to add another set of standards just for technology would be a large task. To achieve compliance to the *Standards* at the elementary level, teachers were encouraged to adapt that which already existed and worked it into their technology projects. The activities were simplistic at the beginning of the year, but as time passed, they became more complex, building on previous learning. There was a blend of project research and hands-on activity. "More in-depth projects are frequently centered around the

History/Social Science SOL objectives or Science SOL objectives" (Whiting, 2002, p. 25). Having the projects centered on core subjects as well as meeting the objectives of the *STL* showed the interdependency that the various sets of standards would have on one another. As time progressed Whiting recommended that teachers continually implement standards in order to keep alignment of *Standards for Technological Literacy* (ITEA, 2000) with the state SOL (Whiting, 2002).

Due to technology's future orientation and dynamic structure, change and implementation will be expected if its goals are to continue to excel. Neither states, districts, or schools should become complacent in their technology education programs. Through professional and educational collaboration, curricula and programs will evolve.

ASSESSMENT OF THE STANDARDS

Development and implementation of the *STL* offers structure and guidance to technology education, but it is just as important to ensure that the students are capturing and comprehending the subject matter being taught. Assessment of the *Standards* is essential for verification of mastery of the content material. In cognitive based subjects this is often accomplished through the administration of a test or quiz. Not all subject matter is strictly cognitive based; there are also affective and psychomotor domains that may need to be addressed (Meyer, 2000). With subjective (judgmental) and objective (no judgment) assessments one can ascertain more fully a student's ability to know, understand and use information and techniques. Its purpose is to provide feedback to the students with respect to their understanding of subject matter or abilities to demonstrate a

specific task/skill. It also notifies instructors of information that needs to be absorbed and retained by the students and areas of concern. This form of quality control helps teachers, curriculum writers, and other professionals with developing, updating, implementing, and interpreting teaching and assessment practices (Meyer, 2000).

In the *Standards for Technological Literacy* (ITEA, 2000) companion document, *Advancing Excellence in Technological Literacy* (2003), student assessment is addressed as a key area in the learning and instructional roles. With the intent that the assessments be implemented in conjunction with the *Standards for Technological Literacy* (ITEA, 2000), they also apply to any classroom K-12, not just technology education classrooms. Through the use of concepts, content, and principles, in addition to memorization, students will be achieving technological literacy (ITEA, 2003). Student assessment, as it has been defined by ITEA (2003) in *Advancing Excellence in Technological Literacy: Development and Program Standards (AETL)*, refers to the systematic, multi-step process of collecting evidence on student learning, understanding, and abilities and using that information to inform instruction and provide feedback to the learner, thereby enhancing student learning (Russel, 2003).

The basic framework with respect to the content, derivation, and accountability of the assessments is set forth in Assessment Standards A1-A5. These state that:

A1 – Assessment of student learning will be consistent with *Standards for Technological Literacy: Content for the Study of Technology* (STL) (ITEA, 2003).

> The broad scope of the individual *STL* benchmarks can be achieved if the underlying objectives and goals are met. The total responsibility will not lie

solely with technology education, but will be achieved through a collaborative multidisciplinary (e.g., physical and social sciences, mathematics, language arts, etc.) approach (ITEA, 2003).

A2 – Assessment of student learning will be explicitly matched to the intended purpose.

This standard sets the precedence for objective based assessments. The final result extends beyond a method to assign a grade or closing out a unit/topic, … assessment should be ongoing (formative) rather than simply marking the end of learning (summative)." (Ritz, Dugger, & Isreal, 2002, p. 245).

A3 – Assessment of student learning will be systematic and derived from research-based assessment principles.

Similar to the curriculum and lessons of the subject matter, assessments should accommodate various levels of cognitive ability, intelligence and build on the skills, knowledge, and experiences learned in other settings of the students' life. As this type of research is conducted and disseminated to the academic community consideration should be given to the implementation of it into curriculums and their corresponding assessment tools (Russel, 2003).

A4 – Assessment of student learning will reflect practical contexts consistent with the nature of technology.

Within this standard students are expected to solve problems, think critically and make decisions based on various learned techniques (Russell, 2003).

A5 – Assessment of student learning will incorporate data collection for accountability, professional development, and program enhancement.

> Each program and its instructors must continually update themselves since technology is constantly changing. Through accountability it can be assured that future thinking and progressive changes occur (Russell, 2003).

It must be recognized that the content and method of assessment will vary on a national, state, and local level. Unlike Mathematics, Science, Language Arts and Social Science Standards of Learning used in Virginia and equivalents from other states which have specific standardized testing and objectives, the *Standards for Technological Literacy* (ITEA, 2000) are voluntary and therefore leave much discretion for implementation and verification to the individual district, school and instructor. This being said there are no specifications to the level and extent of understanding or level of psychomotor proficiency that students must achieve in order to meet the *Standards for Technological Literacy* (ITEA, 2000) assessment benchmarks (Meyer, 2000).

Although the level of understanding and proficiency for achieving *STL* mastery varies nationwide, society is in favor of assessing students' technological knowledge. In the 2001 Gallup poll, Americans were asked several questions about technology. When assessment was addressed, sixty-one percent of those polled agreed that students should be evaluated for technological literacy as part of their high school graduation requirements. Of the 38% of the individuals not in favor of the graduating requirements, 50% were from the 18-29 years old range. It is thought that their reluctance is based

more on the additional graduation requirements rather than technology itself (Rose & Dugger, 2002).

Assessment should not be a surprise to the individual being assessed. Using "backward design" and "teaching to the objectives" are methods by which curriculums and lessons are developed and taught (Russell, 2003; Meyer 2000; Wong, 2002). By starting with the end result in mind, basically the outline, the subsequent information to achieve the end can be inserted and expanded upon depending on the resources and information available to the particular program.

SUMMARY

The International Technology Education Association's release of the *Standards for Technological Literacy* (ITEA, 2000) has provided an educational tool that educators can use to ensure students possess a minimum level of technological knowledge when they complete technology education curriculums. Now that the *Standards* are available, the next challenge lies with their implementation into technology education programs. Once implemented, students will need to be assessed for content mastery. The educators' programs will also need to be assessed to ensure that they are reflective of the *Standards*.

CHAPTER III
METHODS AND PROCEDURES

This chapter will detail the methods and procedures required to complete the intended descriptive study. Included in this chapter will be a description of the population, the instrument design, methods of data collection, and the statistical analysis.

POPULATION

The population for this study was participants of the Virginia Technology Education Association's 2001 summer conference. A list of the attendees was acquired. In attendance at the conference were 174 technology education teachers, supervisors, and university personnel from throughout the Commonwealth of Virginia.

INSTRUMENT DESIGN

A survey, based on the research goals, was used as the instrument to collect the data for this study. It was designed and titled, "Implementation of the *Standards for Technological Literacy* (Survey)". The survey requested demographic information and levels of implementation for the *Standards for Technological Literacy* (ITEA, 2000). The demographic information requested the attendees' name, title/position, school, school location, and grade level taught in technology education. Following the demographic information four questions were asked to determine the level of implementation of the *Standards* and timeframe for implementation and verification that the *Standards* were in-place through the use of formal assessments. The scales used for measurement were percentages and a dichotomous yes/no. Finally, an area was also

provided for general comments that may have been necessary to further answer the questions (See Appendix B for a copy of the survey).

METHOD OF DATA COLLECTION

The survey was mailed and emailed along with a cover letter to all known attendees of VTEA's 2001 summer conference held at Virginia Polytechnic Institute and State University.

The following timeline was established as a guide to complete the study:

> October 27, 2003 - Survey and cover letter sent to attendees of the 2001 VTEA conference.
> November 14, 2003 - Deadline for survey responses to be returned to researcher.

See Appendix C for a copy of the cover letter.

STATISTICAL ANALYSIS

Based on the percentages and dichotomous responses, tables for each question were constructed in order to evaluate the data. Due to the fact that the responses were based on forced percentages (respondents had to choose from the supplied percentages or percent ranges), the final data will be presented in the multiples of twenty-five or dichotomous yes/no respective to the particular questions. This will follow the same pattern as the survey. Based on the number of respondents and corresponding responses, the mean will be calculated as well as percentages and total number of responses for each survey question.

SUMMARY

The contents of this chapter indicate that the population for this descriptive study was the 174 attendees of VTEA's 2001 summer conference held at the Virginia Polytechnic Institute and State University. Each attendee was sent a survey and cover letter designed to gather implementation data for the *Standards for Technological Literacy* (ITEA, 2000). Based on the analysis of these data, Findings (Chapter IV) were presented.

CHAPTER IV
FINDINGS

This chapter presents the data collected from the survey responses and the analysis of the data. The purpose of the study was to determine the level of implementation of ITEA's *Standards for Technological Literacy* for attendees of VTEA's 2001 summer conference.

DATA

Survey Response Level

There were 174 attendees at the 2001 VTEA technology conference. A total of 172 survey packages were sent; addresses for two of the attendees were not available. One respondent to the survey was not on the original list of attendees. A total of 36 (20.8%) responses were received, 122 (70.5%) of the surveys were not returned. The U.S. Postal Service returned 17 (9.8%) of the letters due to insufficient or incorrect address information. Due to the limited number of returned surveys each of respondents' responses will have a greater affect on final averages. With this being noted, general trends were evident when analyzing each of the survey questions. Table 1 depicts the survey response level.

Table 1: Survey Response Level

	Total	Percentage of total (172+1)
Number of attendees	174	
Number of surveys sent	172	
Number of surveys returned by U.S. Postal Service	17	9.8%
Number of responses (one respondent was not on the attendees list of the 2001 VTEA's technology conference)	36	20.8%
Number of non-responses	122	70.5%

ANALYSIS OF DATA

Education Level Taught

The level of education taught by the respondents varied from the elementary school level to the university. In three instances the respondents taught at both the middle school and high school level. The elementary school response was from one individual or 2.7% of the total respondents, while the two responses from the university level compromised 5.4%. The middle school and high school responses were 11 and 24 or 29.7% and 64.9% respectively. Table 2 details the education level taught.

Table 2: Education Level Taught

	Number of Responses	Percentage of Total
Elementary School (E.S.)	1	2.7%
Middle School (M.S.)	11	29.7%
High School (H.S.)	24	64.9%
University	2	5.4%
Total	38	
Note: In three separate instances respondents chose Middle School and High School.		

Overall Level of STL Implementation

The data analysis from 35 respondents indicated an overall level of implementation at the 0-25% range to be 11.4%. At the 26-50% level there was a threefold increase to 34.3% and more than a two and half fold increase (28.6%) in the 51-75% range. The number of respondents in the 76-100% range was nine (25.7%). In Table 3 the overall level of *Standard* implementation is presented.

Table 3: Overall Level of STL Implementation

	0-25%	26-50%	51-75%	76-100%	Total
Number of Responses	4	12	10	9	35
Percentage of total	11.4%	34.3%	28.6%	25.7%	

Timeframe to Reach the 25%, 50%, 75%, or 100% Level of Overall Implementation
A majority of the respondents (31) provided a response to the 100% level of overall implementation. One respondent indicated overall implementation by the end of 2003. Eight respondents expect implementation by the end of 2004, three in 2005, eight in 2006, two in 2007, and one in 2011. Six respondents were not sure when they would achieve 100% implementation.

None of the ten respondents reporting to the 75% implementation level were currently in-place. In 2004, four of the respondents have predicted implementation by September, three by the end of 2005, two by 2006 and one by 2009. Four of the 11 responses indicated 50% implementation of the *Standards* in their programs. The other seven responses suggested implementation within the next four years, four in 2004, two in 2005 and one in 2007. Five responses in the 25% total implementation level indicated December results with two in 2003, two in 2004 and one in 2005.

Level of Implementation for Each Standard
Each of the *Standards for Technological Literacy* (ITEA, 2000) was analyzed to determine its overall level of implementation based on population responses (see Appendix A for a listing of the *Standards*). Two of the standards, STL #14 and STL #15, were below the 30% implementation level and over half of the respondents reported 0% implementation in these areas. At 56.3%, STL #4 had the third lowest overall implementation rate. In the 60-65% range of overall implementation were STL #5, STL #6, STL #13, STL #16, and STL #18. Seven standards fell in the 65-70% overall implementation range including STL #3, STL #7 STL #9, STL #10, STL #12, STL #19

and STL #20. With highest level of implementation were STL #1, STL #2, STL #8, and STL #11 at 70-75%. All of the standards except STL #4, STL #5, STL #14, and STL #15 had over 50% of their responding population at 75-100%. Table 4 depicts the level of implementation for each standard.

Table 4: Level of Implementation for Each Standard

	0%	25%	50%	75%	100%	Total	Average
Standard #1	2	3	6	2	17	30	74.2%
Standard #2	2	4	6	2	17	31	72.6%
Standard #3	2	4	8	3	14	31	68.5%
Standard #4	4	7	4	4	9	28	56.3%
Standard #5	2	5	8	5	9	29	62.1%
Standard #6	3	5	5	4	12	29	64.7%
Standard #7	3	4	9	2	14	32	65.6%
Standard #8	3	4	4	6	15	32	70.3%
Standard #9	3	5	7	3	14	32	65.6%
Standard #10	2	6	7	2	15	32	67.2%
Standard #11	3	3	6	4	16	32	71.1%
Standard #12	2	3	9	6	10	30	65.8%
Standard #13	4	3	6	7	8	28	60.7%
Standard #14	12	3	5	1	2	23	26.1%
Standard #15	13	3	4	1	1	22	20.5%
Standard #16	3	5	2	4	11	25	65.0%
Standard #17	3	1	6	6	12	28	70.5%
Standard #18	4	4	2	8	9	27	63.0%
Standard #19	3	2	6	6	12	29	69.0%
Standard #20	4	2	5	5	12	28	67.0%

Are the Standards Verifiable through Assessment?

For the respondents completing this question, over two-thirds (70.6%) indicated that they could verify that their *Standards* were in-place through the use of assessments. Comments from respondents indicated that they liked the flexibility to create their own assessments, but would like sample assessments to allow them to judge their current

methods. Table 5 shows the respondents' selections for *Standard* verification through assessment.

Table 5: Are the Standards Verifiable through Assessment?

	Number of Respondents	Percentage of Total Number of Respondents
Yes	24	70.6%
No	10	29.4%
Total	34	

SUMMARY

This chapter restated the purpose of the study, which was to determine the level of implementation of ITEA's *Standards for Technological Literacy* (ITEA, 2000) for attendees of VTEA's 2001 summer conference. Upon receiving the returned surveys the data were entered into a table and analyzed for participation, education level taught, overall and specific standard implementation, and assessment verification. Based on these data Chapter V will present a Summary, Conclusions and Recommendations.

CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the research study. Following the summarization, conclusions addressing the research goals are provided. Ending the chapter are recommendations by the researcher based on the data acquired and previous professional experience.

SUMMARY

This study was designed to determine the level of implementation of the *Standards for Technological Literacy* (ITEA, 2000) as developed by the International Technology Education Association (ITEA) for those attendees of the 2001Virginia Technology Education Association (VTEA) summer conference. To accomplish this descriptive research, the population was presented with four questions. The questions presented were:

1. What is the level of overall implementation of the *Standards for Technological Literacy?*
2. What is the level of implementation for each of the *Standards for Technological Literacy?*
3. In what time frame do respondents expect their programs will have the *Standards for Technological Literacy* fully implemented?
4. Is there formal assessment supporting the *Standards for Technological Literacy?*

It is not enough to know that the *Standards for Technological Literacy* (ITEA, 2000) are available and being recommended for implementation into technology education programs. During the literature review for this research none of the reviewed information revealed actual levels of implementation of the *Standards*. This study's significance was that it quantified the level of implementation of the *Standards* into the target population's programs. Not only did the study determine where implementation is currently, it attained a projected implementation schedule for the study population.

The parameters that limited this study were:

a. Not all respondents will have or use the same objectivity or measuring scale to determine if they have implemented the *Standards*.
b. Only those individuals who are members of the Virginia Technology Education Association (VTEA) and attended the 2001 summer conference at Virginia Polytechnic Institute and State University will be surveyed.
c. The target audience for the survey was middle school and secondary school technology educators.
d. The survey period was from October 27, 2003 to November 14, 2003.
e. Not all attendees of the conference continue to teach Technology Education and therefore do not have a need to implement the *Standards for Technological Literacy*.

To ascertain the desired data from this group a survey entitled, "Implementation of the *Standards for Technological Literacy* (Survey)" was used as the instrument of collection.

This survey, which requested demographic information and levels of implementation for the *Standards for Technological Literacy* (ITEA, 2000), was mailed and emailed along with a cover letter to all known attendees of VTEA's 2001 summer conference held at Virginia Polytechnic Institute and State University. The demographic information requested the attendees' name, title/position, school, school location, and grade level taught in technology education. Following the demographic information the four questions were asked to determine the level of implementation of the *Standards*, the timeframe for implementation, and verification that the *Standards* are in-place through the use of formal assessments. The scales used for measurement were percentages and a dichotomous yes/no. Finally, an area was also provided for comments.

Following the return of the surveys, tables for each question were constructed in order to evaluate the data. Since the responses were based on forced percentages the final data is presented in multiples of twenty-five or dichotomous yes/no respective to the particular questions. This follows the same pattern as the survey. Based on the number of respondents and corresponding responses, the mean was calculated, as were percentages, and total number of responses.

At 20.8%, the survey response level was less than the desired 50%. Since the timeframe between the 2001 VTEA technology conference and this survey was over two years, it was expected that some individuals no longer were affiliated with technology education. Several responses on the surveys supported this notion. Although an exact representation of implementation into the total population cannot be made, general trends can be seen.

The survey design had the option for middle school or high school responses, elementary school and university selections were not available. The response level was over twice the number of high school teachers than middle school teacher. The predominant response at these educational levels was expected since they both have programs specifically tailored to technology education. Due to the fact that technology education is also a discipline at the university level and the influence that it has on teachers, future teachers and professional development, the responses from those individuals' were supportive of the *Standards for Technological Literacy* (ITEA, 2000) implementation.

CONCLUSIONS

Using the data collected through the research survey, conclusions will be made based on the research goals.

1. What is the level of over implementation of the *Standards for Technological Literacy?*

One third of the respondents indicated that their programs were in the 26-50% implementation range. Slightly more than one-quarter of the responses were in the 51-75% range and one-quarter of the responses were in the 76-100% range. This indicated that programs vary significantly in levels of total implementation and that more than three-quarters of the programs are less than 75% totally implemented. Before total implementation occurs, much work is needed in creating and modifying programs to meet the *Standards for Technological Literacy* (ITEA, 2000) benchmarks.

2. What is the level of implementation for each of the *Standards for Technological Literacy*?

The two standards with the least implementation are STL #14 and STL #15. The content of these standards emphasizes medical, agriculture, and biotechnology. These subjects have not traditionally been taught in the technology education field and this would explain the great number of individuals reporting 0% implementation. Conversely the standards with the greatest implementation deal with the traditional technology education topics of technology's characteristics, concepts and scope, and attributes and application of design. The remaining standards have approximately two-thirds total implementation in the attendees' programs with over half of the data in the 75-100% range. Here again, the content of these areas has previously been emphasized in technology education.

3. In what time frame do respondents expect their programs will have the *Standards for Technological Literacy* fully implemented?

With only one response of total implementation by the end of 2003, the majority of the remaining respondents will achieve total implementation between 2004 and 2006. Progress is being made for these programs with completion goals set. Over the next four years the majority of programs will be moving forward in their efforts to implement the *Standards for Technological Literacy* (ITEA, 2000). Unfortunately about 20% of the respondents did not know when or if they would totally implement all of the standards. With no projected goal for implementation there is a lack of priority for implementation for reasons not specified. Since not everyone feels that the *Standards for Technological*

Literacy (ITEA, 2000) are appropriate or worth implementing into their curriculums, it was not a surprise to see that one individual indicated that his program would never implement the standards.

4. What is the level of formal assessment supporting the *Standards for Technological Literacy?*

With over 70% of the respondents indicating *Standards* verification through formal assessments, these educators were ensuring that their students are evaluated for content mastery. Even though 30% of the respondents do not have formal assessments for their standards, this is not necessarily indicating that they do not assess their students at all.

RECOMMENDATIONS

The following recommendations are supplied by the researcher based on the data acquired during this study and previous professional experience:

1. A similar study should be conducted in the next two to three years to determine if the *Standards* are being implemented into technology education programs within the timelines suggested through this study. A similar survey could be completed at a future VTEA conference.

2. Teachers should continue to implement the *Standards for Technological Literacy* (ITEA, 2000) into their curriculums at a gradual, but planned pace. During this implementation phase the individuals responsible for implementation should be

reviewing progress, adjusting scheduling and holding individuals accountable for implementation.

3. Even though the *Standards for Technological Literacy* (ITEA, 2000) are not mandatory, it should be noted that if the majority of states and their schools begin to implement them, they will become the norm to which all schools will be expected to comply. This standardization will further ensure minimum learning benchmarks across the state and nation.

4. Ensure that implementation of the *Standards for Technological Literacy* (ITEA, 2000) is a priority for the teacher, the administration and the schools' programs.

5. Ensure that support to implement the *Standards for Technological Literacy* (ITEA, 2000) is available through information exchange, professional development, material availability and future program goals and expectations.

6. The Commonwealth of Virginia should develop instructional materials and assessment instruments to assist with the implementation of the *Standards for Technological Literacy* (ITEA, 2000).

7. Where assessments are appropriate ensure that they are formalized and support the mastery of the *Standards for Technological Literacy* (ITEA, 2000).

8. The Commonwealth of Virginia should become a member of the International Technology Education Association, Center to Advance the Teaching of Technology &

Science so this organization's curriculum and assessment materials become available to its technology education teachers.

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Appendix A - Standards for Technological Literacy

Listing of *Standards for Technological Literacy*

The Nature of Technology

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

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

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

Technology and Society

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

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

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

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

Design

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

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

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

Abilities of a Technological World

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

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

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

The Designed World

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

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

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

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

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

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

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

Appendix B – Survey

Purpose: At the 2001 VTEA Technology Education Summer Conference held at Virginia Tech, attendees were exposed to the twenty "Standards for Technologic Literacy" and recommended to begin implementing them in their Technology Education curriculums. Currently these standards are not required under Virginia's Standards of Learning (SOL) program. This survey is being conducted to assess the level of voluntary implementation of these standards.

Directions: Please read and complete the following information and questions/statements concerning implementation and provide the appropriate response with respect to your school.

(Please Print)
Name: _____
Respondent's title/position: _____
Name of School: _____
School's City/County: _____
Grade Level(s): ☐ Middle School ☐ High School

1) To what overall level of implementation of the 20 Standards would this school's program fall?
☐ 0% - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76-100%

2) What standards do you consider as being in ___ place? (see standard listings on page 2*)
100% - (e.g. 1,2,3,6,8,10, etc.)_____
75% - _____
50% - _____
25% - _____
0% - _____

3) In what time frame would you reasonable expect overall implementation to be ___?
100% - (e.g. Dec 2004)_____
75% - _____
50% - _____
25% - _____

4) For the standards in place, could they be verified as in place through the use of a final assessment? ☐ Yes ☐ No

Comments: _____

When completed please return to Scott Sonier, Old Dominion University, Department of Occupational Technical Studies, Norfolk, VA 23529-0050. Any question may also be directed to 757-683-5229 or ssonier@odu.edu.

***Supporting information for question number two.**

Listing of *Standards for Technological Literacy*

The Nature of Technology

Standard 1: Students will develop an understanding of ***the characteristics and scope of technology.***
Standard 2: Students will develop an understanding of ***the core concepts of technology.***
Standard 3: Students will develop an understanding of ***the relationships among technologies and the connections between technology and other fields of study.***

Technology and Society

Standard 4: Students will develop an understanding of ***the cultural, social, economic, and political effects of technology***.
Standard 5: Students will develop an understanding of ***the effects of technology on the environment.***
Standard 6: Students will develop an understanding of ***the role of society in the development and use of technology***.
Standard 7: Students will develop an understanding of ***the influence of technology on history.***

Design

Standard 8: Students will develop an understanding of ***the attributes of design.***
Standard 9: Students will develop an understanding of ***engineering design.***
Standard 10: Students will develop an understanding of ***the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.***

Abilities of a Technological World

Standard 11: Students will develop abilities to apply ***the design process.***
Standard 12: Students will develop abilities to ***use and maintain technological products and systems.***
Standard 13: Students will develop abilities to ***assess the impact of products and systems***.

The Designed World

Standard 14: Students will develop an understanding of and be able to select and use ***medical technologies.***
Standard 15: Students will develop an understanding of and be able to select and use ***agricultural and related biotechnologies.***
Standard 16: Students will develop an understanding of and be able to select and use ***energy and power technologies.***
Standard 17: Students will develop an understanding of and be able to select and use ***information and communication technologies.***
Standard 18: Students will develop an understanding of and be able to select and use ***transportation technologies.***
Standard 19: Students will develop an understanding of and be able to select and use ***manufacturing technologies.***
Standard 20: Students will develop an understanding of and be able to select and use ***construction technologies.***

Appendix C - Survey Cover Letter

October 27, 2003

Dear Technology Educator,

You and your colleagues have been selected as recipients of the enclosed survey due to your attendance at the 2001 Virginia Technology Education Association technology conference held at Virginia Tech. At that conference attendees were exposed to the twenty Standards for Technological Literacy and recommended to begin implementing them in their Technology Education curriculums. Currently these standards are not required under Virginia's Standards of Learning (SOL) programs. This survey is being conducted to assess the level of voluntary implementation of these standards. Where do you stand; where does Technology Education stand? Following your completion and return of the survey, an analysis of the data will be performed. This evaluation will indicate your and the other attendees level of commitment to the standards and more specifically updating your technology education programs.

This is an Old Dominion University supported project; your consent to use your completed questionnaire information must be attained. For the purposes of this study, completing and returning the enclosed survey will serve as your consent to use the data. Please understand that your personal information will not be used as part of the analysis; it will be kept confidential. It will be used only by me in order to determine who has responded. If you do not wish to participate you may simply discard the survey or return it unfinished.

Please complete the survey and return it, using the enclosed self-addressed envelope by November 14, 2003. Thank you for your participation

Respectfully,

Scott Sonier
Old Dominion University

John Ritz, Ed.D.
Chairman, Occupational and Technical Studies
Old Dominion University

enclosure