The Equipment Needs of the Standards for Technological Literacy

Julian B. Duffey

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The Equipment Needs of the Standards for Technological Literacy

A Research Paper
Presented to the Graduate Faculty of
The Department of Occupational and Technical Studies
At Old Dominion University

In Partial Fulfillment
of the Requirements for the
Master of Science in Occupational and Technical Studies

By
Julian B. Duffey

December 2004
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APPROVAL PAGE

This research paper was prepared by Julian Duffey under the direction of Dr. John M. Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Master of Science in Occupational and Technical Studies.

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CHAPTER I
INTRODUCTION

Technology Education is problem-based learning utilizing mathematics, science and technology principles (ITEA, 1995). Emerging from the shadow of Industrial Arts in the 1980s, the adoption of Technology Education involved the renaming of programs, restructuring of courses, and making corresponding changes in facilities. Wood shop and welding have been replaced with materials technology and computer-aided design. With this rapid change in curriculum and content, some guidance was needed to ensure a smooth transition into a fully viable educational program. The International Technology Education Association (ITEA) has provided much guidance for the profession.

ITEA is the largest professional educational association, principal voice, and information clearinghouse devoted to enhancing technology education through experiences in our schools (K-12). Its membership encompasses individuals and institutions throughout the world with the primary membership in North America (ITEA, 1995). In 1994, ITEA, in cooperation with NASA and the NSF created the Technology for All Americans Project (TfAAP). The TfAAP was designed to bring to the forefront a program to increase the technological literacy of American students.

TfAAP was to be completed in three phases.


The primary focus of Phase II was content standards for the study of technology. Published in 2000, *Standards for Technological Literacy: Content for the Study of Technology (STL)*, outlines the
content essential to ensuring that all students attain technological literacy. The standards are built around both a cognitive base as well as a doing/activity base and include knowledge, abilities, and the capacity to apply both knowledge and abilities to the real world.

Phase III of TfAAP produced *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards (AETL)* in 2003. Serving as a companion document to STL, AETL provides a means for implementing STL in laboratory-classrooms by addressing such important topics as student assessment, professional development, and program enhancement (ITEA, 2004).

Now that a learning philosophy, its content and the assessments necessary to implement it were established, there needed to be a professional development arm of the ITEA to implement and adapt the Standards for Technological Literacy and allow the continued professional development of educators. In 1998 the Center to Advance the Teaching of Technology and Science (CATTS) was created to meet this need.

CATTS meets the above need by promoting the use of the Standards for Technological Literacy, providing teacher workshops and conferences, developing and disseminating educational materials, and promoting partnerships with agencies or organizations to advance technological literacy and student achievement. One of CATTS’s primary interests is the widespread adoption of the Standards for Technological Literacy by individual state departments of education. Currently there are twelve states that have official CATTS state representatives and have adopted the Standards for Technological Literacy. Though CATTS addresses issues of content and philosophy, thus far it has not put forward a recommended list of equipment educational institutions could use to assist in implementing the Standards for Technological Literacy. Addressing this issue is the topic of this paper.
STATEMENT OF THE PROBLEM

The problem of this study was to determine the equipment needs of Technology Education programs that have implemented the Standards for Technological Literacy.

RESEARCH GOALS

These goals were analyzed to produce a standard equipment list for CATTS to recommend for implementation in participating states. It sought to:

1. Determine the equipment needs for elementary education programs implementing the Standards for Technological Literacy.
2. Determine the equipment needs for middle school education programs implementing the Standards for Technological Literacy.
3. Determine the equipment needs for high school education programs implementing the Standards for Technological Literacy.

BACKGROUND AND SIGNIFICANCE

With its inception in 1998, CATTS took on the responsibility as the professional development arm of the ITEA. With this came the responsibility of creating standards-based curricula and providing the curriculum guides for implementing technological literacy. Many states have recommended equipment lists for technology education programs. These have resulted because of guidelines needed to obtain federal and state funds. However, with the new CATTS curriculum, no recommendations are made for laboratory development.
In December, 2003, Dr. John Ritz, Chair of Occupational and Technical Studies at Old Dominion University was approached by Dr. Len Sterry, CATTS Director, regarding the lack of a common K-12 Technology Education equipment list that supports the *Standards for Technological Literacy*. This lack of a common equipment list that supports the *Standards for Technological Literacy* is not unexpected considering the rapid rate of advance in the Technology Education curriculum, but it presents some problems. Without a common equipment list it is harder to assess the efficacy of *Standards for Technological Literacy* based instruction, since it is possible that each state is starting from a different baseline of available equipment.

**LIMITATIONS**

This research was limited to the twelve states that have adopted the *Standards for Technological Literacy* and have established CATTS representatives within their educational system; together these make up the CATTS consortium. Participating CATTS states may not have equipment lists to support the *Standards for Technological Literacy*. The primary data for this research was obtained from CATTS representatives from the states of Virginia, Georgia, Utah, Tennessee, North Carolina, North Dakota, Wisconsin, Maryland, Kentucky, Missouri, Ohio, and Florida. Further information was obtained from the *Standards for Technological Literacy*, Occupational and Technical Studies departmental staff at Old Dominion University, the Virginia Department of Education and the Technology for All American’s Project.
ASSUMPTIONS

Each participating state may have three levels of Technology Education programs: elementary, middle school and high school. Though they all can use Standards for Technological Literacy, there is no common equipment list provided by CATTS to support the three different educational levels. Because of this, each state has created their own equipment list for middle school and high school and may or may not have a list for elementary school. These individual equipment lists will differ from each other and may or may not meet the needs of fully implementing the Standards for Technological Literacy. By gathering and analyzing the participating states current technology education equipment lists and comparing them to the Standards for Technological Literacy, a common equipment list can be discerned to meet the needs of the three grade levels.

PROCEDURES

The information gathered was compiled and presented to show the preparedness of each state in meeting the equipment needs of the Standards of Technological Literacy. The research goals will be supported with data obtained by web search from the twelve CATTS consortium states implementing the Standards for Technological Literacy and through electronic mail or phone conversations with their representatives. Additional data will be obtained from the content from the Standards for Technological Literacy, Old Dominion University departmental staff, the Virginia Department of Education and the Technology for All American’s Project.
DEFINITION OF TERMS

These abbreviations and terms are in this research report and are implemented as follows:

**CATTS** The Center to Advance the Teaching of Technology & Science (CATTS) was established in 1998 to strengthen professional development and advance technological literacy. CATTS initiatives are directed toward four goals: development of standards-based curricula; teacher enhancement; research concerning teaching and learning; and curriculum implementation and diffusion (ITEA, 1995).

**ITEA** The International Technology Education Association is the largest professional educational association, principal voice, and information clearinghouse devoted to enhancing technology education through experiences in our schools (K-12). Its membership encompasses individuals and institutions throughout the world with the primary membership in North America (ITEA, 1995). Originally founded in 1939 as the American Industrial Arts Association, the name change occurred in 1985.

**Modular Instruction** An environment that is organized such that students rotate among content modules in which all of the instructional materials and equipment are provided, requiring minimal assistance from the teacher.

**Standards for Technological Literacy** Outlines the content essential to ensuring that all students attain technological literacy. The standards are built around both a cognitive base as well as a doing/activity base and include knowledge, abilities, and the capacity to apply both knowledge and abilities to the real world (ITEA, 1995).
Technology  “A system based on the application of knowledge, manifested in physical objects and organizational forms, for the attainment of specific goals” (Volti, 2001, p. 6).

Technology Education  Problem-based learning utilizing math, science and technology principles (ITEA, 1995).

TfAAP  The Technology for All Americans Project created by the ITEA and funded by the National Science Foundation and National Aeronautics and Space Administration. It was created to increase the student attainment of technological literacy.

OVERVIEW OF CHAPTERS

In Chapter I, the field of Technology Education was introduced and the history of the ITEA and CATTS was covered in brief as was the lack of a CATTS based common equipment list to support the Standards for Technological Literacy. The problem statement was introduced as were the background and significance, limitations, assumptions, procedures and definition of terms.

Chapter II will be a review of literature on the history of technology education, the Standards for Technological Literacy, CATTS, and a brief overview of technology education laboratories. Chapter III will contain information on the methods and procedures of the research including population, methods of data collection, analysis and summary. Chapter IV will include a brief curriculum overview of each member of the CATTS consortium, their equipment list, which grade levels the Standards for Technological Literacy are implemented, and the
findings that will be drawn from the equipment information gathered. Chapter V will present a summary of the research conducted, conclusions, and recommendations for a *Standards for Technology Education* based equipment list.
CHAPTER II
REVIEW OF LITERATURE

The Standards for Technological Literacy are the foundation for an effective technology education program. This chapter will present a discussion on the history of technology education, the Standards for Technological Literacy, and CATTS's role in technology education. Also covered will be a brief overview of technology education laboratories.

THE BIRTH OF TECHNOLOGY EDUCATION

Technology education evolved from what was originally industrial arts in the first half of the 1980s. Of all the disciplines in the educational system, it was industrial arts that had a rich heritage in helping students understand their technical heritage, albeit these had been geared to the past and been represented out of context (Lauda & McCrory, 1986, p. 28). Though industrial arts had been educating students successfully for almost a half of a century, three problems remained pervasive throughout its tenure:

1. The programs were materials project orientated, making them involved with technical processes without conscious concern for the sociocultural context in which they exist.

2. Industrial arts had not been involved with all of the technical means in most programs. The Standards Report (Dugger, 1980) revealed that most programs were still based on the teaching of woodworking, metalworking, and drafting.

3. Programs have not kept pace with the changing technology. Updating laboratories to reflect contemporary technology is cost prohibitive and alternatives to this problem had not been a high priority for many teachers (Lauda & McCrory, 1986, pp. 28-29).
Technology education provided an elegant solution to these problems.

Technology involves the application of knowledge, resources, materials, tools, and information in designing, producing, and using products, structures (physical and social) and systems to extend human capability to control and modify natural and human-made environments (Raizen, 1995, p. 1). Technology education involves the study of technology, its cultural effects, and laboratory based instruction relevant to the rapidly changing pace of our technological society. With its instruction based on technological concepts and principles, technology education provides students with the ability to make sense of the fast-paced world and be prepared to take a place of responsibility in it.

The ITEA was at this time the American Industrial Arts Association (AIAA). Created in 193 9, the AIAA was composed of a group of individuals who were interested in furthering the educational principles taught in industrial arts classes (Starkweather, 1995). Through the organized efforts of its members the organization sought to better its profession and the world it operated in providing curriculum guidance, workshops, and instructor education information.

Industrial arts was very appropriate in an industrial era when skills in woodworking and metalworking were the focus of subject matter being taught in schools. As the world moved toward advanced uses of such technological advances as computer chips in a more sophisticated, fast-moving society, teachers found it necessary to make adjustments in their thoughts, teaching styles, and the directions of the association that represented them. (Starkweather, 1995, p. 545)

To keep pace with the rapidly changing world, in 1985 the AIAA changed its name to the ITEA and technology education officially became an educational discipline. In addition the AIAA journal entitled The Industrial Arts Teacher became ITEA’s
Man/Society/Technology, and then later it changed its name to The Technology Teacher. What is the end result of the change to technology education? A student gains a comprehension of the technological process allowing them to better make sense of, and utilize, the technologically complex world they are a part of.

THE STANDARDS FOR TECHNOLOGICAL LITERACY

From its inception there was confusion about what exactly technology education was and how to implement it. The inability to settle on a single definition of technology education is due in part to the multiple definitions given to technology. The search for clarity about what technology is, and consequently about what technology education might be, is essential (Todd, 1989). Technology Education in the Classroom, describes the core of the problem in detail when it asks:

But what is technology education, and what is its role in the school curriculum? Ask any K-12 educator in the United States and you will be told that technology is already a part of the curriculum taught in his or her school, classroom, and district. When pressed to elaborate, he or she may refer to the use of technology in delivering instruction: the use of computer laboratories in elementary schools, the provision of vocational courses that use sophisticated equipment and aim to prepare the students for skilled technician jobs... They may also describe such courses as Chemistry in the Community (referred to as ChemCom) that embed the teaching of scientific concepts in a technological context; design-orientated projects that culminate in projects meeting certain specifications; science classes that follow up presentations of theory with discussions of technological applications; or science-technology-society courses that deal with societal issues that have some scientific and technological components.

If all this and more is occurring already, why is there a need for a book that urges all schools to make technology education a key component of the K-12 curriculum? The answer lies precisely in the level of confusion as to what technology education is, and in the lack of coherence of the activities that most schools offer under this label. Notions such as the ones given above demonstrate this confusion,
because they fail to distinguish between the use of educational technologies (devices for facilitating learning) and technology education (which aims to help students understand, use, and evaluate the effects of current and emerging technologies). If coherent carefully planned sequences of technology education from kindergarten through twelfth grade were to be found with any frequency in the schools of America, we could simply report on them, presenting a synopsis of the alternative ways in which schools are meeting the challenge of linking science with technology and technology with other subjects. This is not the case. In most instances where schools do offer technology education, it comes in bits and pieces – an isolated project here, a replacement unit there, or at best, a single yearlong course that provides in-depth treatment of a few topics, but offers no continuity or sequence from one year to the next (Raizen, 1995, p. 3)

Kendall N. Starkweather, Executive Director of the ITEA, had already noticed a discrepancy and a need for some sort of standards to technology education when in 1993 he wrote, “While a majority of the states have some type of curriculum guide for technology education. The state guides cover such areas as manufacturing, construction, transportation or communications. This is important to note for there is no national curriculum for technology education in the United States at this time” (Starkweather, 1993, p. 20). The need for a set of common professional technology education standards was very clear. States were interpreting what technology education was and how it was to be taught with no common standards or definitions.

As mentioned above, the ITEA was not unaware and in 1994 action had already begun.

In 1994 with funding from NASA and the NSF, the ITEA commenced The Technology for All Americans Project (TfAAP). The project was designed to change the face of technology education in the United States and the world by providing a strong definition of technology and technology education, providing base standards
for attaining technological literacy, and providing classroom guidance for
implementing technology education in laboratory settings. The TfAAP was to be
completed in three phases.

Commenced in 1994 and completed in 1996, the ITEA published *Technology for All Americans: A Rationale and Structure for the Study of Technology*. This
constituted phase one of the TfAAP.

The document was the product of the experiences, knowledge, and
advice of hundreds of professionals in technology education and other
fields, including science, mathematics, engineering, and the
humanities. In headings like “The Power and Promise of Technology,”
“A Structure for the Study of Technology,” and “The Need for
Technological Literacy,” it explains why technology education is
important (Singletary, 1997, p. 12).

This document lays the philosophical foundation for the study of technology in
K-12 laboratory-classrooms and articulates the essential role of schools in developing
technologically literate citizens (ITEA, 1995). By providing the guidelines for what
each person should know in order to be technologically literate, the document
provides a research bridge into phase two which is the creation of the *Standards for
Technological Literacy*.

The *Standards for Technological Literacy* were published in 2000, though
they gestated over many years. They were designed by

a 27-member standards team, composed of teacher educators,
administrators, classroom teachers, and experts in technology
education, science, mathematics, and engineering divided into three
subteams: one for grades K-2 and 3-5, one for grades 6-8, and one for
grades 9-12. The role of the standards team is to propose, evaluate, and
approve the content of the standards (Singletary, 1997, p. 13).

When completed the document became the guide for educating students in
developing technological literacy. The *Standards for Technological Literacy* contain
twenty content standards (Appendix A), and five chapters that represent one of five major categories that the standards are organized into:

1. The Nature of Technology (Chapter 3)
2. Technology and Society (Chapter 4)
3. Design (Chapter 5)
4. Abilities for a Technological World (Chapter 6)
5. The Designed World (Chapter Seven)

Each chapter begins with a narrative that defines a category, explains the importance of each topic within a category, and gives a brief overview of the chapter (ITEA, 2000, p. 14).

These standards do several things for the field of technology education. They provide identity, recognition, organization, and direction (Hook, 2001, p. 31). It must be noted that the *Standards for Technological Literacy* are not a curriculum, but rather a guide showing what content should be included in a technology education curriculum for K-12 schools. The *Standards for Technological Literacy* do what had been needed in technology education; they provide a common framework of terms and definitions, present standards to be implemented throughout the K-12 architecture, and tie technology education with other content areas of education.

The last phase of the TfAAP project was completed in 2003 with the publication of *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (AETL). A companion to the *Standards for Technological Literacy*, the document addressed the important topics of student assessment, professional development, and program enhancement (ITEA, 1995).
With the birth of the TfAAP and the *Standards for Technological Literacy* there needed to be a professional development arm of the ITEA. It needed a department dedicated to providing support to states and educators implementing the *Standards for Technological Literacy*. In 1998 the Center to Advance the Teaching of Technology and Science (CATTs) was created to meet that need.

CATTs

CATTs promotes the use of the *Standards for Technological Literacy*, professional development, and the attainment of technological literacy. CATTs initiatives are directed towards four goals:

1. Development of standards-based curricula
2. Teacher enhancement
3. Research concerning teaching and learning

CATTs provides teacher enhancement opportunities through selected programs, workshops and conferences ranging from the elementary to university level, development of resource materials and support of teaching environments. CATTs also develops and disseminates educational materials through consortium work involving participants from states/provinces through local educational agencies or groups. Promoting partnerships with agencies, organizations, and other associations to advance technological studies in order to achieve common goals for developing technological literacy and improving student achievement is also under the purview of CATTs (ITEA, 1995).

CATTs also utilizes a consortium to generate support, identify interest and maintain a commitment to the teaching of technology and science. The consortium
allows participating agencies to pool resources and build alliances in order to speed solutions to educational problems. Consortium members pay a fee under a contractual agreement to receive special products and services specific to their local and professional development needs.

TECHNOLOGY EDUCATION LABORATORIES

With the introduction of technology education, there was a need to redefine the educational laboratory to reflect the new discipline. Industrial arts laid a foundation for laboratory design that was very effective with planning the proper implementation of courses such as woods, metals, and engineering drawing. The three major types of laboratory organizations for the teaching of industrial arts were the unit, general unit and comprehensive general shop (Proctor, 1959, p. 37).

The unit type of organization provides concentration in one specific area. A single topic of instruction is located in one laboratory area, providing concentrated instruction in one specific discipline. A general unit laboratory is an industrial arts laboratory which is equipped to provide instruction in two or more phases of a single industrial area (Proctor, 1959, p. 41). The comprehensive general laboratory is a laboratory in which various disciplines are addressed with various different activities arranged into a general course to meet student needs and interest.

Though industrial arts has been replaced with technology education, these basic laboratory designs are still with us in the educational environment. Technology education shies away from a unit or general unit approach and favors the comprehensive general laboratory arrangement. With the multi-disciplinary approach
of technology education this makes sense, since in this type of laboratory multiple
areas of study can be addressed at one time enabling new areas of study to be
included like biotechnology or communication technology. The old unit or general
unit labs can also be quickly retrofitted to become comprehensive laboratories. This
allows the quick transition of schools from industrial arts to technology education.

The modern version of the comprehensive unit laboratory is now known as a
modular laboratory. In this arrangement there are various “modules” that allow small
groups of students to focus on a particular area while other groups can be working on
other areas on different projects. Essentially different hubs of the same wheel, each
module area can be addressed and tied into the greater whole of the class. This
modular approach encourages exploration, enables one-on-one instruction, increases
teacher efficiency and enables maximum use of space for multiple activities.

Laboratory supply companies have also made respective changes to respond
to the new demand for technology education modular sections and labs. New
technology education materials are constantly being introduced, with individual
module cost varying from $1000 to over $10000.

It would be remiss to not point out that though industrial arts has had total
laboratory guides and equipment lists published, technology education has not.
Instead there has been the approach of assuming a standard base of equipment left
over from the industrial arts age and a decision to build upon that foundation by
addition of modules or subjects rather than providing equipment listings or laboratory
guides that supports the field of K-12 technology education in its entirety.
SUMMARY

Technology education has had a bit of a tumultuous start throughout the late
eighties and nineties. From the shadow of industrial arts emerged the ideal of
technological literacy. The ITEA through the TfAAP and the introduction of the
Standards for Technological Literacy has managed to take a nascent educational field
and give it a universal definition and set of educational standards. CATTS, through
its professional development programs and consortium members, has served to
strengthen the emergence of technology education as a solid part of the nation’s K-12
curriculum. As we can see through the brief overviews of laboratory equipment there
is still work to be done in the area of equipment requirements that support the
Standards for Technological Literacy.
CHAPTER III
METHODS AND PROCEDURES

This research has examined how the Standards for Technological Literacy came into being. This chapter reviews the details on how the data were gathered for this research and how the data are to be presented. The topics for this chapter include population, instrument design, methods of data collection, statistical analysis and a summary. Information for this research were obtained by web searches from the twelve CATTs consortium states implementing the Standards for Technological Literacy and through phone conversations with their representatives. Additional data were obtained from the content from the Standards for Technological Literacy, Old Dominion University departmental staff, the Virginia Department of Education and the Technology for All American’s Project.

POPULATION

The population for this research were the twelve participating states of the CATTs consortium. The states that composed the population were: Virginia, Georgia, Utah, Tennessee, North Carolina, North Dakota, Wisconsin, Maryland, Kentucky, Missouri, Ohio and Florida.

INSTRUMENT DESIGN

The technology education equipment listing for each member of the CATTs consortium was obtained from the state’s CATTs representative who are listed in Appendix B. The curriculum and equipment listing websites from each consortium
state appear in Appendix C. The data collected are to be presented as a descriptive research study, compared within a matrix.

METHODS OF DATA COLLECTION

The technology education equipment listings and curriculums were obtained from the World Wide Web or directly from the appropriate CATTS representative. Any data related to the Standards for Technological Literacy were obtained directly from that document, from the ITEA website or from the departmental staff of the Technology Education Program at Old Dominion University, Norfolk, Virginia.

STATISTICAL ANALYSIS

The different technology education equipment listings collected from the CATTS consortium states were contrasted in a matrix.

SUMMARY

The equipment listings from each of the states in the CATTS consortium were collected and organized into a matrix. State CATTS representatives not only provided the requested information but did so in a prompt and courteous manner willing to entertain any further requests for information. The results of the data collected will be presented in Chapter IV.
CHAPTER IV

FINDINGS

When the change from industrial arts to technology education occurred there was confusion as to how to implement the equipment change. With industrial arts there was already an equipment base in place and it was a short jump to change some material around and have a technology laboratory. This approach was acceptable for the early stages of implementing technology education, but it is no longer an acceptable substitute when implementing the Standards for Technological Literacy.

In the interest of providing a brief snapshot of the state of this problem, the following data presented below were from the CATTS consortium, states curriculum and equipment listing websites provided in Appendix C.

Of the twelve states in the CATTS consortium, ten responded to queries for information (83%). In order to avoid any possible reporting errors, non-responders have been left out of the study. The following is an overview of information collected from the ten responding states with Table 1 providing a quick reference to summarize the information.

FLORIDA

The technology education curriculum in Florida utilizes the Standards for Technological Literacy. The curriculum addresses grades 6-12 with a link to CATTS educational resource material. While there is a statewide curriculum for technology education, only Exploration of Communications Technology (under the Integrated
Technology Studies middle school program) has a recommended equipment list supporting the *Standards for Technological Literacy*.

Table 1: CATTS states and their implementation of the *Standards for Technological Literacy*

<table>
<thead>
<tr>
<th>States</th>
<th>Technology curriculum in place?</th>
<th>Implementing a standards based curriculum that supports the <em>Standards for Technological Literacy</em>?</th>
<th>Has supporting equipment list for elementary level?</th>
<th>Has supporting equipment list for middle school level?</th>
<th>Has supporting equipment list for secondary school level?</th>
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</table>
GEORGIA

Georgia has state-level technology content standards for primary, middle and secondary school levels. There are four content standards presented: Nature of Technology, Human Ingenuity, Technological Systems, and Impact of Technology. Each standard has supporting criteria to be achieved by the grade levels of five, eight and twelve.

Georgia curriculum represents an intense effort to integrate both the Georgia Academic Standards for Technology Education and the Standards for Technological Literacy. The curriculum includes basic class frameworks, standards met, and example student activities with evaluative criteria for middle and secondary school levels. Support materials provided with the content standards and curriculum represent an effort to present a basic technology laboratory layout to guide the development of a modern laboratory. Georgia addresses physical plant issues and suggests basic floor plans, instructional methods, utilities, and furniture. There is no common equipment listing to support the Standards for Technological Literacy.

KENTUCKY

Kentucky has a statewide set of technological literacy standards in place and has supporting curriculum and performance indicators for primary, middle and secondary grade levels. This curriculum is in support of the National Education Technology Standards (NETS) put forth by the International Society for Technology in Education (ISTE). Currently there is no standards based equipment list or
curriculum for Kentucky, though there are some basic laboratory guidelines that are in progress (Appendix C).

MARYLAND

Maryland is currently undergoing a lengthy revision of their current content standards for technology education. The current content standards and curriculum support the grade levels of 6-12. The new standards will incorporate the same grade levels but will be supportive of the *Standards for Technological Literacy*. There is currently no standards based equipment list or curriculum for Maryland.

MISSOURI

Missouri has an exhaustive technology education curriculum that supports the *Standards for Technological Literacy* for the elementary, middle and secondary grade levels. The document provides an overview of the various standards associated with the different grade levels, Missouri laboratory safety guidelines and a supporting guide to laboratory layout to support space requirements for middle and secondary grade levels. There are no equipment guidelines to support the *Standards for Technological Literacy* however.

NORTH CAROLINA

North Carolina has a technology education curriculum for the middle and secondary grade levels. The curriculum presents basic course outlines and refers back to the *Standards for Technological Literacy* as a guide for grade specific
benchmarks. There is also a recommended equipment list to support the complete technology education curriculum.

NORTH DAKOTA

North Dakota has adopted the CATTS guides as a framework for their state technology education curriculum. The curriculum covers the elementary, middle and secondary grade levels and mirrors the *Standards for Technological Literacy*. There is no supporting equipment list accompanying the state technology education curriculum.

OHIO

Requested data not provided.

TENNESSEE

Tennessee has adopted the *Standards for Technological Literacy* as the guidelines for their state technology education standards. The curriculum in place covers the middle and secondary grade levels and presents course descriptions, example laboratory activities and competency profiles. There is no supporting equipment list.

UTAH

Utah has established state curriculum standards for middle and secondary grade levels. The *Standards for Technological Literacy* provide the framework for
the state standards which have supporting class descriptions and benchmarks for student achievement. Program implementation and equipment procurement are left to local districts. There is no supporting equipment list.

WISCONSIN

Requested data not provided.

VIRGINIA

Virginia has a state instituted technology curriculum for the elementary, middle and secondary levels. There are state instituted standards that the curriculum follows that are set forth by the Technology Education Service and provided through Virginia’s Career and Technical Education Center (CTE). The curriculum also has a comprehensive recommended equipment listing to support its goals. Though the curriculum and equipment list follow the guidelines set forth by the Technology Education Service, they do not follow the Standards for Technological Literacy.

SUMMARY

Of the ten responding states, all have instituted a technology education curriculum; seven are instituting a curriculum that directly adopted the Standards for Technological Literacy. Eight of the states had no supporting equipment list for their technology education programs; North Carolina had an equipment list supporting the middle and secondary school levels and Virginia supported elementary, middle and secondary levels.
CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In the last twenty years technology education has come from a nascent discipline in need of definition and direction to an accepted discipline with defined educational standards. This chapter will present a brief overview of the research problem, the research conclusions, recommendations for a Standards for Technological Literacy based equipment list and recommendations for further research.

SUMMARY

The problem of this study was to determine the equipment needs of Technology Education programs that have implemented the Standards for Technological Literacy and produce a standard equipment list for CATTS to recommend for implementation in participating states. The research goals were to:

1. Determine the equipment needs for elementary education programs implementing the Standards for Technological Literacy.
2. Determine the equipment needs for middle school education programs implementing the Standards for Technological Literacy.
3. Determine the equipment needs for high school education programs implementing the Standards for Technological Literacy.

The significance of this study was that although many states have recommended equipment lists for technology education programs, with the new CATTS curriculum, no recommendations are made for laboratory development.
supporting the *Standards for Technological Literacy*. The research was limited to the twelve states that are members of the CATTS consortium; these states also made up the population for the study.

The technology education equipment listing for each member of the CATTS consortium was obtained from the states CATTS representative who were listed in Appendix B. The curriculum and equipment listing websites from each consortium state appeared in Appendix C.

The technology education equipment listings and curriculums were obtained from the World Wide Web or directly from the appropriate CATTS representative. Any data related to the *Standards for Technological Literacy* were obtained directly from that document, from the ITEA website or from the departmental staff of the Technology Education Program at Old Dominion University, Norfolk, Virginia.

CONCLUSIONS

The data from the ten CATTS states that participated in this study show clearly that although technology education curriculum has been adopted in all CATTS states, a recommended equipment list supporting the curriculum is not. The goals of this research were threefold:

1. Determine the equipment needs for elementary education programs implementing the *Standards for Technological Literacy*.
2. Determine the equipment needs for middle school education programs implementing the *Standards for Technological Literacy*. 
3. Determine the equipment needs for high school education programs implementing the *Standards for Technological Literacy*.

The assumptions were that each state would have a recommended equipment list for implementing their technology education curriculum, unfortunately no programs are operating under a common equipment list that supports the standards and as of yet there is no standards-based published equipment listing. All three research goals can be answered simultaneously. Given the current condition of equipment listings in the CATTS consortium states, it is not possible to determine the precise equipment needs of the individual states implementing the *Standards for Technological Literacy*, since there is no common technology equipment listing to support the standards. It is conceivable however, that if one were created it could form a common framework for participating CATTS states to follow as a guideline when instituting the *Standards for Technological Literacy* in the grade levels of K-12.

**RECOMMENDATIONS**

The following listing is put forth as a recommended equipment guideline for a CATTS originated K-12 technology education program instituting the *Standards for Technological Literacy*. It was created using the existing CATTS consortium members equipment listings, the *Standards for Technological Literacy* and technology education supply catalogs from various vendors. The list is split into three grade-level segments with a modular laboratory and comprehensive unit laboratory listing for per segment (with the exception of the elementary level). The equipment provided in the recommended lists can meet all of the grade-level
benchmarks provided by the *Standards for Technological Literacy* but only creative instruction can ensure that they are met. The following lists are presented using common modules or equipment available at all of the current manufacturers of technology education equipment.

**ELEMENTARY LEVEL EQUIPMENT LISTING**

At the elementary level it can be assumed that any technology education program would be instituted utilizing the same general subjects teacher and classroom. As such the recommended list present a portable approach to meet the benchmarks set forth in the *Standards for Technological Literacy* and assumes the students have access to basic supplies such as scissors, glue, tape, paper straws, craft sticks, and a media laboratory.

**K-5 Equipment List**

Introduction to Technology Module with supporting lesson plans
-the module consists of various interactive labs
-Meets Standards 1-14, 16-20

Forms of Energy Display Board
- Shows the different types of energy sources
-Meets Standards 5, 7, 16, 13

White Wings Science of Flight Kit
- Explores basic aerodynamic principles
-Meets Standards 1-6, 8-12, 18

Rocketry Project Pack
- Enables investigation into rocketry basics
-Meets Standards 1-6, 8-12, 18

Mousetrap Car Project Pack
- Introduction to transportation technology
-Meets Standards 1-6, 8-12, 18
Basic Model Building Kit
-Kinex or Capsela provide insight into machines and basic tools
-Meets Standards 1-2, 8-13

Hydroponics or Horticulture Kit
-Provides introduction to biotechnology
-Meets Standards 1-7, 14-17

Instructional Videos
-Videos relating to the areas of Communication Technology, Construction Technology, Manufacturing Technology, and Energy and Transportation Technology
-Meets Standards 1-7, 14-20

Introduction to the Internet Software
-Enables students to become aware of the vastness of communication technology
-Meets Standards 1-4, 6, 12-13, 17

MIDDLE SCHOOL LEVEL EQUIPMENT LISTING

At the middle school level there is some shift from multiple curriculum taught in one classroom to the teaching of different curricula in various specialized classrooms because of the increasing population of students. It can be assumed that technology education is being taught in a newer modular classroom or in an older industrial arts class. With this in mind there are two recommended lists presented to support Standards for Technological Literacy, one for modular instruction and the other for a comprehensive unit laboratory. This list assumes an existing base of equipment exists and will therefore not suggest miscellaneous tools. In the case of the modular laboratory, computer access is assumed, and for the comprehensive unit laboratory, access to a media center.
6-8 Modular Equipment List

Aerospace Module
- Includes virtual model design and testing software
- Meets Standards 1-4, 6-8, 12-13, 17-18

Energy Module
- Examines different forms of energy production
- Meets Standards 1-10, 12-13, 16

Automotive Design Module
- Includes wind tunnel and CO2 car track
- Meets Standards 1-13, 18-19

Communication Technology Module
- Familiarizes students with the internet and authoring software
- Meets Standards 1-4, 6-8, 11-13, 17

Computer Aided Design Module
- Enables students to learn the basics of virtual design
- Meets Standards 1-3, 6-8, 10-13, 17

Drafting Module
- Enables students to learn the basics of mechanical drawing
- Meets Standards 1, 3, 6, 8, 10-13, 17, 19

Materials and Processes Module
- Enables students to learn the basics of manufacturing and construction technologies
- Meets Standards: 1-3, 5-8, 10, 12-13, 19-20

Introduction to Technology Module
- The module consists of various interactive labs
- Meets Standards 1-14, 16-20

Bridge Building Module
- Enables students to examine construction technology
- Meets Standards 1-3, 5-13, 20

Biotechnology Module
- Enables students to explore the new field of biotechnology
- Meets Standards 1-17

Instructional Videos
- Videos relating to the areas of Communication Technology, Construction Technology, Manufacturing Technology, and Energy and Transportation Technology
- Meets Standards 1-7, 14-20
6-8 Comprehensive Unit Laboratory Equipment List

Model Plane/Rocket Building Kits
- Examine Aerospace fundamentals
- Meets Standards 1-4, 6-8, 12-13, 17-18

Solar Power Kits
- Examine different forms of energy production
- Meets Standards 1-10, 12-13, 16

Power Production Display
- Examine different forms of energy production
- Meets Standards 1-10, 12-13, 16

CO2 Car Kits and Racetrack
- Examine transportation technology and design fundamentals
- Meets Standards 1-13, 18-19

Authoring Software
- Familiarizes students with communication technology
- Meets Standards 1-4, 6-8, 11-13, 17

Computer Aided Design Software
- Enables students to learn the basics of virtual design
- Meets Standards 1-3, 6-8, 10-13, 17

Drafting Cabinet w/Supplies
- Enables students to learn the basics of mechanical drawing
- Meets Standards 1, 3, 6, 8, 10-13, 17, 19

Materials Tester
- Enables students to learn the basics of manufacturing and materials testing
- Meets Standards 1-3, 5-8, 10, 12-13, 19

Bridge Building Kits
- Enables students to examine construction technology
- Meets Standards 1-3, 5-13, 20

Hydroponics Lab Kits
- Enables students to explore the new field of biotechnology
- Meets Standards 1-17

Instructional Videos
- Videos relating to the areas of Communication Technology, Construction Technology, Manufacturing Technology, and Energy and Transportation Technology
- Meets Standards 1-7, 14-20
SECONDARY SCHOOL LEVEL EQUIPMENT LISTING

At the secondary school level technology education changes the intensity of study but not necessarily the topics of study. The secondary equipment listing borrows much from the middle school listing with some differences, mainly the addition of other modules due to the increased class time that accompanies the switch to secondary school. A marked increase in the academic achievement expected of students and the complexity of standards based benchmarks also occurs. While the researcher is addressing the needs of only the basic technology education course that all students must take, there are also various electives allowed to secondary school students. Depending on the school and district these are usually construction technology, manufacturing technology, communication technology, transportation technology, and drafting and design.

9-12 Modular Laboratory Equipment List

Aerospace Module
- Includes virtual model design and testing software
- Meets Standards 1-4, 6-8, 12-13, 17-18

Energy Module
- Examines different forms of energy production:
- Meets Standards 1-10, 12-13, 16

Automotive Design Module
- Includes wind tunnel and CO2 Car track
- Meets Standards 1-13, 18-19

Communication Technology Module
- Familiarizes students with the internet and authoring software
- Meets Standards 1-4, 6-8, 11-13, 17
Computer Aided Design Module
- Enables students to learn the basics of virtual mechanical design
- Meets Standards 1-3, 6-8, 10-13, 17

Digital Photography Module
- Enables students to learn the basics of image manipulation and photographic composition.
- Meets Standards 1-3, 6-7, 9-12, 16

Drafting Module
- Enables students to learn the basics of mechanical drawing
- Meets Standards 1, 3, 6, 8, 10-13, 17, 19

Electronics Module
- Enables students to learn the basics of electrical circuitry
- Meets Standards 1-3, 6-8, 10, 12-13, 16

Engineering Module
- Enables students to explore the basics of design and construction
- Meets Standards 1-3, 5-13, 20

Materials and Processes Module
- Enables students to learn the basics of manufacturing and construction technologies
- Meets Standards 1-3, 5-8, 10, 12-13, 19-20

Introduction to Technology Module
- The module consists of various interactive labs
- Meets Standards 1-14, 16-20

Robotics Module
- Enable students to understand basic robotics and electronics
- Meets Standards 1-4, 6-8, 10-13, 19

Biotechnology Module
- Enable students to explore the new field of biotechnology
- Meets Standards 1-17

MAGLEV Racer Module
- Enable students to explore future transportation methods
- Meets Standards 1-13, 18-19

Instructional Videos
- Videos relating to the areas of Communication Technology, Construction Technology, Manufacturing Technology, and Energy and Transportation Technology
- Meets Standards 1-7, 14-20
9-12 Comprehensive Unit Laboratory Equipment List

Model Plane/Rocket Building Kits
- Examine Aerospace fundamentals
- Meets Standards 1-4, 6-8, 12-13, 17-18

Solar Power Kits
- Examine different forms of energy production:
- Meets Standards 1-10, 12-13, 16

Power Production Display
- Examine different forms of energy production
- Meets Standards 1-10, 12-13, 16

Authoring Software
- Familiarizes students with communication technology
- Meets Standards 1-4, 6-8, 11-13, 17

Basic House Construction Kits
- Enables students to explore the basics of design and construction
- Meets Standards 1-3, 5-13, 20

Bridge Building Kits
- Enables students to examine construction technology
- Meets Standards 1-3, 5-13, 20

CO2 Car Kits and Racetrack
- Examines transportation technology and design fundamentals
- Meets Standards 1-13, 18-19

Computer Aided Design Software
- Enables students to learn the basics of virtual design
- Meets Standards 1-3, 6-8, 10-13, 17

Digital Cameras with Software
- Enables students to learn the basics of image manipulation and photographic composition.
- Meets Standards 1-3, 6-7, 9-12, 16

Drafting Cabinet w/Supplies
- Enables students to learn the basics of mechanical drawing
- Meets Standards 1, 3, 6, 8, 10-13, 17, 19

Electronic Project Kits
- Enables students to learn the basics of electrical circuitry
- Meets Standards 1-3, 6-8, 10, 12-13, 16
Hydroponics Lab Kits
- Enables students to explore the new field of biotechnology
- Meets Standards 1-17

Instructional Videos
- Videos relating to the areas of Communication Technology, Construction Technology, Manufacturing Technology, and Energy and Transportation Technology
- Meets Standards 1-7, 14-20

MAGLEV Racer Kits with Two-Piece MAGLEV Track:
- Enables students to explore future transportation methods
- Meets Standards 1-13, 18-19

Materials Tester
- Enables students to learn the basics of manufacturing and materials testing
- Meets Standards: 1-3, 5-8, 10, 12-13, 19

Robot Class Kits
- Enables students to understand basic robotics and electronics
- Meets Standards 1-4, 6-8, 10-13, 19

RECOMMENDATIONS FOR FURTHER RESEARCH

Further research should be conducted to determine the feasibility of CATTS putting forward a single national equipment list or if there should be a variety of listing based on various geographic areas and their individual educational and financial challenges. Additional research could be conducted associating specific projects and equipment with corresponding grade-level and standard met, instead of focusing on multiple grade levels, as does this study. The research could focus on just elementary, middle or secondary levels. Research into equipment listings is also necessary in the specialized subject areas afforded secondary school students as electives. Finally, after CATTS develops additional curricular products, the participant states should review the lists and determine if these lists meet their needs or if additional equipment needs to be added to the different grade levels.
BIBLIOGRAPHY


In R. E. Jones & J. R. Wright (Eds), *Implementing Technology Education.*

(p. 28). New York: Glencoe.


In R. E. Jones & J. R. Wright (Eds), *Implementing Technology Education.*

(p. 28-29). New York: Glencoe.


(p. 41). Illinois: McKnight & McKnight.


APPENDICES

APPENDIX A

The 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 for 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.

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.

The complete Standards for Technological literacy can be found at:
http://www.iteawww.org/TAA/Publications/STL/STLMainPage.htm
APPENDIX B

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APPENDIX C

CATTS State Curriculum and Equipment Listing Websites

FLORIDA

Florida Curriculum Website:
http://www.firm.edu/doe/programs/te_home.htm

GEORGIA

Technology Education Site:
http://www.uga.edu/teched/doe/

Georgia Technology Education Standards:
http://www.uga.edu/teched/doe/standards.html

Curriculum Framework:
http://www.uga.edu/teched/doe/framework.html

Support Materials:
http://www.uga.edu/teched/doe/support.html

KENTUCKY

Technology Education State Webpage:
http://www.education.ky.gov/KDE/Instructional+Resources/Technology/Student+Initiatives/Student+Technology+Standards/default.htm

Some Considerations
When Selecting Equipment and Designing Facilities for the 2005 Technology Education Program of Studies in Kentucky

The Program of Studies for Technology Education emphasizes laboratory experiences. Teachers are encouraged to get tools and materials in the hands of students as often as feasible. Students should be designing, building, testing, and modifying various projects in every class.

Facilities
An ideal facility for Technology Education would not limit the materials or processes that could be experienced. It would include a “clean” area for computers and other classroom activities (such as student presentations) and a “lab” area for activities without regard to dust, odor/fumes, or noise. A single teacher should be able to supervise both the clean area and the lab area simultaneously. Overall, the facilities should be very flexible to accommodate a variety of activities.

The clean area should include:
- An area where the teacher or students could give presentations to the entire class
- Desks/tables that can be arranged into groups
- Computers with engineering/drawing software. Data collection and analysis software could also be useful.
- Printers and Plotters

The lab area should include:
- Secure tool storage
- Secure student project storage
- Area where equipment not currently being used can be set aside
- Storage for raw materials, (string, tape, wood scraps, plastic pipes, foam, dowels, and other small items that are very useful. Certainly not to be confused with large, elaborate wood and metal storage racks)
- Work benches that can be re-arranged as required for the current tasks.
- Tools and equipment that can be moved as necessary (and removed and/or locked when not needed)
- Sufficient space for individuals or groups to work at a table or on the floor
- An outside door if at all possible.
- Adequate ventilation so odors/fumes do not pose a problem
- An area where students could work on an engine without damaging anything.
- An area where welding could be done
- Lots of electrical outlets so that arrangement of the room is not dependent upon availability of power
- Adequate lighting

Equipment
The lab should be equipped with tools and equipment that allow the teacher to select a wide variety of projects. Basically, the student should be able to cut, form, and join just about any material they need for their project. The technology lab should not be confused with a vocational lab or an Industrial Arts lab. The Technology lab does not need large, expensive, industrial equipment. In many cases, table top equipment will work just fine. The following is a list of tools and equipment that would be helpful in a well-equipped technology lab for 24 students.

- 2 small drill presses, possibly 1 floor drill press
- 2 belt/disc sanders
- 2 hand saws
- 4 scroll saws
- 1 table saw (primarily for teacher use only)
- 1 power compound miter saw
- 110 volt wire welder
- 1 or 2 small wood lathes
- 4 hand drills with various bits and hole saws
- 2 portable belt sanders (3”x21”)
- 3 vibrator sanders
- 2 “Dremel” tools
- 2 routers with various bits
- 2 jig saws
- 1 portable circular saw (primarily for instructor use)
- Assortment of chisels, squares, and hammers
- Assortment of wrenches, sockets, and pliers
- 6 hot glue guns
- 12 scissors
- 4 utility knives
- 8 Tape measures/rulers
- 6 Hand saws
- 2 stopwatches
- Sensitive digital scale
MARYLAND

Framework for Technology Education:

http://www.mcps.k12.md.us/curriculum/teched/

MISSOURI

State Technology Education Curriculum:

http://dese.mo.gov/divcareered/teched_curriculum.htm

NORTH CAROLINA

Course of Study:


Equipment guide:


NORTH DAKOTA

State Technology Education Curriculum:

http://www.state.nd.us/cte/secondary/programs/tech-ed/

OHIO

Requested data unavailable
TENNESSEE
State Technology Education Standards and Curriculum:

http://www.k-12.state.tn.us/voced/vetestandards.html

UTAH
State Technology and Engineering Education Standards and Curriculum:

http://www.usoe.k12.ut.us/ate/Teched/tech.htm

WISCONSIN
Requested data unavailable

VIRGINIA
Technology Education Access site:

http://www.pen.k12.va.us/VDOE/Instruction/CTE/

State Technology Education Standards, Curriculum and Equipment Listing:

http://www.pen.k12.va.us/VDOE/Instruction/CTE/te/

CTE Resource Center

http://www.cteresource.org/