Realizing Excellence:

Structuring Technology Programs

Addenda Series to—*Standards for Technological Literacy: Content for the Study of Technology* and *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*

International Technology Education Association

ITEA Technology for All Americans Project (TfAAP)

ITEA Center to Advance the Teaching of Technology and Science (CATTS)

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“Never doubt that a small group of thoughtful, committed citizens can change the world, indeed it’s the only thing that ever has.”

– Margaret Mead
(1901-1978, Citation Unknown)

Preface

With increased support for educational standards, educators need resources to help them engage in standards-based reform. The International Technology Education Association (ITEA) is publishing a series of addenda for this purpose. *Realizing Excellence: Structuring Technology Programs* offers educators and other concerned individuals suggestions and tools for planning, developing, implementing, and evaluating standards-based technology programs. Several individuals helped make this document possible, and acknowledgements are provided in Appendix A.

Community support exists for technological study. In 2001 and 2004, ITEA/Gallup Polls on "What Americans Think About Technology" revealed that American citizens nearly unanimously supported the need for technological literacy and the need to study technology in schools to increase technological literacy for all people (Rose & Dugger, 2002; Rose, Gallup, Dugger, & Starkweather, 2004). Technology program development, implementation, and evaluation will require leadership, commitment, and support from educators, parents, and communities. Working together, users of *Realizing Excellence* can achieve the vision that all students can and should become technologically literate.

Section 1 of *Realizing Excellence* provides an introduction to standards-based technology programs. Section 2 introduces five questions of standards-based planning for use in judging the current state of technology programs. Section 3 offers a "snap-shot" view of what standards-based programs look like. Section 4 provides direction to its users as they plan technological study for their schools and school districts. Section 5 provides direction to educators as they evaluate and revise technology programs consistent with the program standards in chapter 5 of *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003). *Realizing Excellence* is rooted in these program standards. The program standards are aligned with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002) and were developed to be implemented in conjunction with *STL*. And finally, Section 6 discusses the need to focus on effective change. Several appendices provide helpful information and forms to help users achieve standards-based technology programs.

Realizing Excellence is most useful when users are already familiar with the technology content standards in *STL* and the companion standards for student assessment, professional development, and program enhancement in *AETL*. However, users may find *Realizing Excellence* helpful as a bridge to understanding the vision of the standards as it pertains to program enhancement. Other addenda to *STL* and *AETL* focus on standards-based student assessment (*Measuring Progress*), professional development of educators (*Developing Professionals*), and curricula (*Planning Learning*). See pages iv–v for a listing of the ITEA Professional Series publications. ITEA welcomes feedback on all of the guides in this addenda series as we work together to ensure technological literacy for all students.

Advancing Technological Literacy: ITEA Professional Series

The Advancing Technological Literacy: ITEA Professional Series is a set of publications developed by the International Technology Education Association (ITEA) based on *Standards for Technological Literacy* (ITEA, 2000/2002) and *Advancing Excellence in Technological Literacy* (ITEA, 2003). The publications in this series are designed to assist educators in developing contemporary, standards-based K–12 technology education programs. This exclusive series features:

- Direct alignment with technological literacy standards, benchmarks, and guidelines.
- Connections with other school subjects.
- Contemporary methods and student activities.
- Guidance for developing exemplary programs that foster technological literacy.

Titles in the series include:

Technological Literacy Standards Series

- *Standards for Technological Literacy: Content for the Study of Technology*
- *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*
- *Technology for All Americans: A Rationale and Structure for the Study of Technology*

Addenda to Technological Literacy Standards Series

- *Realizing Excellence: Structuring Technology Programs*
- *Developing Professionals: Preparing Technology Teachers*
- *Planning Learning: Developing Technology Curricula*
- *Measuring Progress: A Guide to Assessing Students for Technological Literacy*

Engineering By Design: Standards-Based Technological Program Series

Elementary School Resources

- *Technology Starters: A Standards-Based Guide*
- *Models for Introducing Technology: A Standards-Based Guide*

Middle School Resources

- *Teaching Technology: Middle School, Strategies for Standards-Based Instruction*
- *Exploring Technology: A Standards-Based Middle School Model Course Guide*
- *Invention and Innovation: A Standards-Based Middle School Model Course Guide*
- *Technological Systems: A Standards-Based Middle School Model Course Guide*

High School Resources

- *Teaching Technology: High School, Strategies for Standards-Based Instruction*
- *Foundations of Technology: A Standards-Based High School Model Course Guide*
- *Engineering Design: A Standards-Based High School Model Course Guide*
- *Impacts of Technology: A Standards-Based High School Model Course Guide*
- *Technological Issues: A Standards-Based High School Model Course Guide*

Engineering By Design: Standards-Based Technological Study Lessons

Elementary School Resources

- Kids Inventing Technology Series (KITS)

Elementary/Middle School Resources (Grades 5–6)

- Invention, Innovation, and Inquiry (I^3) Units
  - — *Invention: The Invention Crusade*
  - — *Innovation: Inches, Feet, and Hands*
  - — *Communication: Communicating School Spirit*
  - — *Manufacturing: The Fudgeville Crisis*
  - — *Transportation: Across the United States*
  - — *Construction: Beaming Support*
  - — *Power and Energy: The Whispers of Willing Wind*
  - — *Design: Toying with Technology*
  - — *Inquiry: The Ultimate School Bag*
  - — *Technological Systems: Creating Mechanical Toys*

Secondary School Resources

- Humans Innovating Technology Series (HITS)

Note: All of the publications in the ITEA Professional Series are available online at www.iteawww.org or by contacting:

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ITEA: Teaching Excellence in Technology, Innovation, Design, and Engineering (TIDE)

SECTION 1

Programs for the Study of Technology: An Introduction

This section provides an introduction to standards-based technology programs.

Technological literacy **is a relatively new term in education. In basic terms,** ***technological literacy*** **is the ability to use, manage, evaluate, and understand technology.**

Technology **is the innovation, change, or modification of the natural environment to satisfy perceived human needs and wants.**

A happenstance approach to technological literacy is an irresponsible choice.

Realizing Excellence **regards its users as the leadership necessary for realizing standards-based technology programs in schools nationwide.**

Technological literacy for every citizen is one of the most important educational goals of the twenty-first century. Citizens who are technologically literate are vital to human welfare and national economic prosperity. As the U.S. Commission on National Security/21st Century reported in 2001: "The health of the U.S. economy . . . will depend not only on [science, math, and engineering] professionals but also on a populace that can effectively assimilate a wide range of new tools and technologies" (p. 39). **All individuals must be technologically literate to be successful in the technological world in which we live.**

Prior to the twenty-first century, the study of technology was largely ignored in formal education. This was due, in part, to a surge of technological advances that occurred after traditional curriculum parameters were established. As a result, most of us have gained what technological literacy we have through our daily activities or personal interests. However, in this emerging millennium, **technological processes and systems have become so complex and have become incorporated into our lives to such a degree that the happenstance approach to technological literacy is clearly an irresponsible choice.**

Leadership: Taking Action to Make Change

While the expertise and resources available to individual users will vary, the strategies presented in *Realizing Excellence* can be used by anyone who supports the vision of technological literacy for all students by Grade 12. As Robert Marzano states in his 2003 document, *What Works in Schools: Translating Research into Action*, "…leadership could be considered the single most important aspect of effective school reform" (p. 172). *Realizing Excellence* regards its users as the leadership necessary for realizing standards-based technology programs in schools nationwide.

Realizing Excellence calls on teachers, administrators, and communities to work together to take action and make change. We, as educators and other concerned individuals, must create standards-based programs that meet the needs of our students and communities, while being dedicated to furthering student technological literacy. Technological literacy must be a goal of the entire community, not just a goal of one individual.

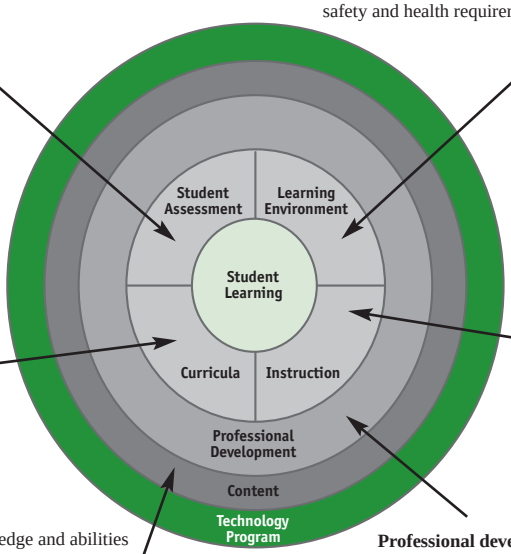
Program Defined

The word *program* is a broad term in education. Program includes content, professional development, curricula, instruction, student assessment, and the learning environment (see Figure 1) implemented across grade levels. For example, a middle school program would include everything that affects student learning in Grades 6–8 in a school or school district (ITEA, 2003, pp. 13–15). On a larger scale, a district-wide program would consider everything that affects student learning in Grades K–12.

Figure 1. Selected Program Components

Student assessment is a process of collecting data on student knowledge, understanding, and abilities that teachers can use to help students achieve. It is systematic, and the evidence collected should be used to refine instruction and provide feedback to the learner.

The **learning environment** is the place where instruction occurs. It may occur in a classroom or a laboratory or outside of the school, as on a field trip. It consists of such things as space, equipment, resources (including supplies and materials), and safety and health requirements.



Curricula are the way the content is delivered each day in the laboratory-classroom. Curricula include the structure, organization, balance, and presentation of the content to the student and provide the plan followed by the teacher for instruction. *STL* is not a curriculum.

Instruction is the teaching process used by the teacher to deliver the content to all students. It involves various teaching methods, strategies, and techniques. Effective instruction requires an understanding of how students learn.

Content lays out the knowledge and abilities students should learn to become technologically literate. Content is the subject-matter ingredients that go into the curriculum. Content for the study of technology across Grades K-12 is provided in *STL*.

Professional development refers to the training teachers need to be able to teach the content. It is a continuous process of lifelong learning and growth that begins early in life, continues through the undergraduate, pre-service experience, and extends through the in-service years.

The primary purpose of any program is to facilitate and enhance student learning. Content, professional development, curricula, instruction, student assessment, and the learning environment must be coordinated for student learning to be effective.

Educators **refers to those professionals involved in the teaching and learning process, including teachers and administrators. The term *administrators* is used when referring to those professionals who manage any aspect of the educational system, including supervisors, principals, or teachers as appropriate.**

The *technology program* **refers to everything that affects student attainment of technological literacy. This includes content, professional development, curricula, instruction, student assessment, and the learning environment, implemented across grade levels as a core subject of inherent value.**

Purpose of an Educational Program for the Study of Technology

The purpose of programs for the study of technology is to enable **all** students in Grades K–12 to become technologically literate. Educators accomplish this by basing programs on educational standards. The International Technology Education Association (ITEA) published *Standards for Technological Literacy: Content for the Study of Technology (STL)* in 2000 and its companion document, *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards (AETL)*, in 2003. ***STL* and *AETL* are the only nationally-accepted educational standards for technological literacy.** [1]

Technological Literacy Standards

STL contains 20 standards that detail a broad base for technological literacy. These 20 standards are organized under five major dimensions (categories):

- The Nature of Technology
- Technology and Society
- Design
- Abilities for a Technological World
- The Designed World

A listing of the content standards can be found in Appendix B. Under each of the 20 standards, there are numerous benchmarks, which provide more detail to

[1] Funding for the development of these sets of standards was provided by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). *Standards for Technological Literacy* is supported by the National Research Council (NRC).

the standards. The benchmarks are grouped into grade "bands" (i.e., K–2, 3–5, 6–8, 9–12).

The purpose of *AETL* is to advance the technological literacy of all students. *AETL* helps *STL* be put into practice by addressing standards for:

- The successful characteristics of *student assessment* (see Appendix C);
- The necessary aspects of *professional development* of educators (see Appendix D); and
- The scope of quality *programs* for the study of technology (see Appendix E).

Realizing Excellence focuses on the program standards (see Table 1).

Within *Realizing Excellence*, the term *content standards* refers to the standards in *STL*. The term *technological literacy standards* refers to the standards in both *STL* and *AETL*.

Table 1. Program Standards from *AETL*

P-1.	Technology program development will be consistent with *Standards for Technological Literacy: Content for the Study of Technology (STL)*.
P-2.	Technology program implementation will facilitate technological literacy for all students.
P-3.	Technology program evaluation will ensure and facilitate technological literacy for all students.
P-4.	Technology program learning environments will facilitate technological literacy for all students.
P-5.	Technology program management will be provided by designated personnel at the school, school district, and state/provincial/regional levels.

Technological Literacy: What is it?

Technological literacy is a fairly new expression in education. In basic terms, technological literacy is the ability to use, manage, evaluate, and understand technology. The National Academy of Engineering (NAE) and the National Research Council (NRC), in their publication, *Technically Speaking: Why All Americans Need to Know More About Technology* (2002), describe it as a "…capacity to understand the broader technological world rather than an ability to work with specific pieces of it" (p. 22). "Technological literacy encompasses three interdependent dimensions—knowledge, ways of thinking, and capabilities . . . . Like literacy in reading, mathematics, science, or history, the goal of technological literacy is to provide people with the tools to participate intelligently and thoughtfully in the world around them" (p. 3).

"Technological literacy is much more than just knowledge about computers and their application. It involves a vision where each citizen has a degree of knowledge about the nature, behavior, power, and consequences of technology from a broad perspective." (ITEA, 1996, p. 1)

Enduring concepts, or *big ideas*—which is the term used in this document—are the large, important, profound, and lasting ideas that will remain valid over a long period of time (Wiggins & McTighe, 1998; ITEA, 2004).

The time has come for educators, policymakers, and the community at large to value technological study as a core subject that teaches about the humanly-modified world.

The study of technology to attain technological literacy (technology education) is distinct and different from the study of computers or the use of computers and other media to enhance teaching and learning (educational technology).

Technology Partnerships

For all students to achieve technological literacy, educators must accept that all students can and should become technologically literate. We must believe that technology education is valuable to students as a subject that not only enhances other school subjects but incorporates subject-specific enduring concepts, or *big ideas* (Wiggins & McTighe, 1998). These big ideas affect the abilities of all students to lead successful, fulfilling, and active roles in society throughout their lives.

Language arts teaches reading and writing. Science teaches about the natural world. Mathematics teaches the principles that are ordered by numbers and symbols. The time has come for educators, policymakers, and the community at large to value technology education as a core school subject that teaches about the humanly-modified world.

A technology partnership among teachers, administrators, and the community will help these ideals become realized. Standards-based reform is an objective to which technology educators, as pioneers in the standards movement, should be especially committed. The remainder of *Realizing Excellence* focuses on creating standards-based technology programs. As educators and other concerned individuals, we must work together to decide what actions we can take to realize excellence in our schools and create programs that support the study of technology across Grades K–12.

SECTION 2

Planning New or Improved Standards-Based Technology Programs

This section introduces five questions of standards-based planning and incorporates a form for judging the current state of technology programs.

As Douglas Reeves (2002) states in *The Leader's Guide to Standards*, "…the mere existence of a standards document achieves nothing. It is the diligence with which teachers and school leaders implement standards that is of greater importance" (p. 10). Once educators are aware of the technological literacy standards—what they are, why they are important—they must decide how to build their programs around them. In his 2002 article, Rodger Bybee reported the following strategic framework for standards-based reform that was established for the *National Science Education Standards* (NRC, 1996) project (see Table 2).

Table 2. Strategic Framework for Standards-Based Reform

Dissemination	Goal: Developing Awareness	"Getting the word out"
Interpretation	Goal: Increasing Understanding and Support	"Getting the idea"
Implementation	Goal: Changing Policies, Programs, and Practices	"Getting the job done"
Evaluation	Goal: Monitoring and Adjusting Policies, Programs, and Practices	"Getting it right"
Revision	Goal: Improving the Efficacy and Influence of Standards	"Doing it all again"

Evaluation **refers to the process of collecting and processing information and data to determine how well a program and its various components meets the requirements and to provide direction for improvements. For purposes of clarification, in *Realizing Excellence,* as in the other addenda documents, the term *assessment* is only used to refer to student assessment.**

Realizing Excellence is intended to assist technology program leadership as they implement, evaluate, and revise standards-based programs that support the study of technology. Section 3 provides educators with a "snap-shot" view of what standards-based programs look like. Section 4 addresses how educators can "get the job done." Section 5 provides direction to educators as they "get it right" and "do it all again" through program evaluation and revision consistent with the program standards in chapter 5 of *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003).

Considering the Big Picture

Creating standards-based programs requires that users of *Realizing Excellence* make changes to policies, programs, and practices to align teaching and learning with technological literacy standards. We, as program leaders, must create a system that supports student attainment of technological literacy across grade

levels and disciplines. Before program leaders begin making any changes, they will want to consider the current state of technological study within their schools and school districts by answering questions such as those that follow.

Where are we now?

To determine the current status of the program, we look at everything from the overall structure of the technology program to the elements that affect student learning. We examine all aspects of the program, including professional development, curricula, instruction, student assessment, and the learning environment, in relation to technological literacy standards.

- Are program elements aligned with technological literacy standards?
- Is student learning in other content area classrooms aligned with the technology program and with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002)?
- Whom do our programs serve?
- What service do we provide?
- Does the study of technology occur across grade levels? *(*AETL *Program Standard 1, Guidelines D & K)*
- Are the technology laboratory-classrooms provided in middle and high schools specifically designed to promote the study of technology?
- Is technological study required for all students? *(*AETL *Program Standard 1, Guideline H)*
- Are licensed teachers employed to deliver technology content? *(*AETL *Program Standard 2, Guideline E)*
- What is the current state of technology content, professional development, curricula, instruction, student assessment, and learning environments?

Note: Appendix F is a form for educators to use in judging the current state of technology programs within their schools and school districts. This form is not intended to represent a comprehensive evaluation. Rather, it is a tool to facilitate initial planning. The final column on the form will be of use in evaluation, which is discussed in Section 5 of *Realizing Excellence*.

Where do we want to go?

Program leaders consider the priorities of the school and community to establish where programs should be "taking" students. What do graduates need to know and be able to do related to technology? The standards to which a school or school district is committed will help answer this question and may include national, state, and/or local standards (Carr & Harris, 2001). *Realizing Excellence* asserts that technology programs should be aligned with *STL* and

AETL, as they are the only nationally-accepted educational standards for technological literacy. Students should learn very basic technological ideas in early elementary school and more complex ideas in middle and high school. Additionally, program leaders promote content that supports school district, state/provincial/regional, and national/federal standards in other academic areas *(*AETL *Program Standard 1, Guideline I)*.

A *stakeholder* is any individual or entity who has an interest in the success of the technology program. Technology program stakeholders may include teachers, administrators, school leaders, professional development providers, parents, business and industry leaders, engineers, scientists, and technologists, among others.

How are we going to get there?

The answer is a matter of program management—ensuring that adequate resources are available to accomplish missions, goals, and curricular objectives. Not only is it a matter of effective content, professional development, curricula, instruction, student assessment, and learning environments, it is a matter of providing funding, support, and resources. *Realizing Excellence* is intended to help teachers and administrators "get there." Accomplishing the program goals depends upon ensuring that appropriate resources are available for teachers to teach and students to learn.

What actions must stakeholders take to move the study of technology from its current state within the program to the desired future state of technological study? Answering questions such as: *Where are we now?* and *Where do we want to go?* will enable program leadership to determine how to "get there" by outlining the specific activities and needed resources for moving the program forward.

What knowledge and abilities must educators possess to get there?

Professional development, both pre-service and in-service, helps educators "get there" by providing opportunities based on educators' needs and, ultimately, the needs of K–12 students. Teachers are responsible for their own continued professional growth. Administrators support the sustained professional growth of all educators and recruit technologically competent teachers of technology. Together, teachers and administrators plan and revise technology programs by attending to what they need to learn. Educators seek professional development opportunities that provide them with the knowledge and skills needed to ensure schools and school districts have the necessary personnel for facilitating the study of technology across grade levels and disciplines.

How will we know when we have arrived?

We will know when we have arrived based on the results of program evaluation. Technology program leadership should implement systematic and continuous

evaluation that verifies the quality of technology programs and ensures that all students are achieving technological literacy *(*AETL *Program Standard 3, Guidelines B & H*). Content, professional development, curricula, instruction, student assessment, and the learning environment should be evaluated in light of technological literacy standards. Successes as well as setbacks should be reported to program stakeholders, and revisions based on program evaluation should occur. The goal is for all students to achieve technological literacy. Section 5 of *Realizing Excellence* provides direction to users as they evaluate and revise standards-based programs. Additionally, the third column in Appendix F, the form which can be used to establish the current state of technology programs, will also be of use in the evaluation process, as explained in Section 5.

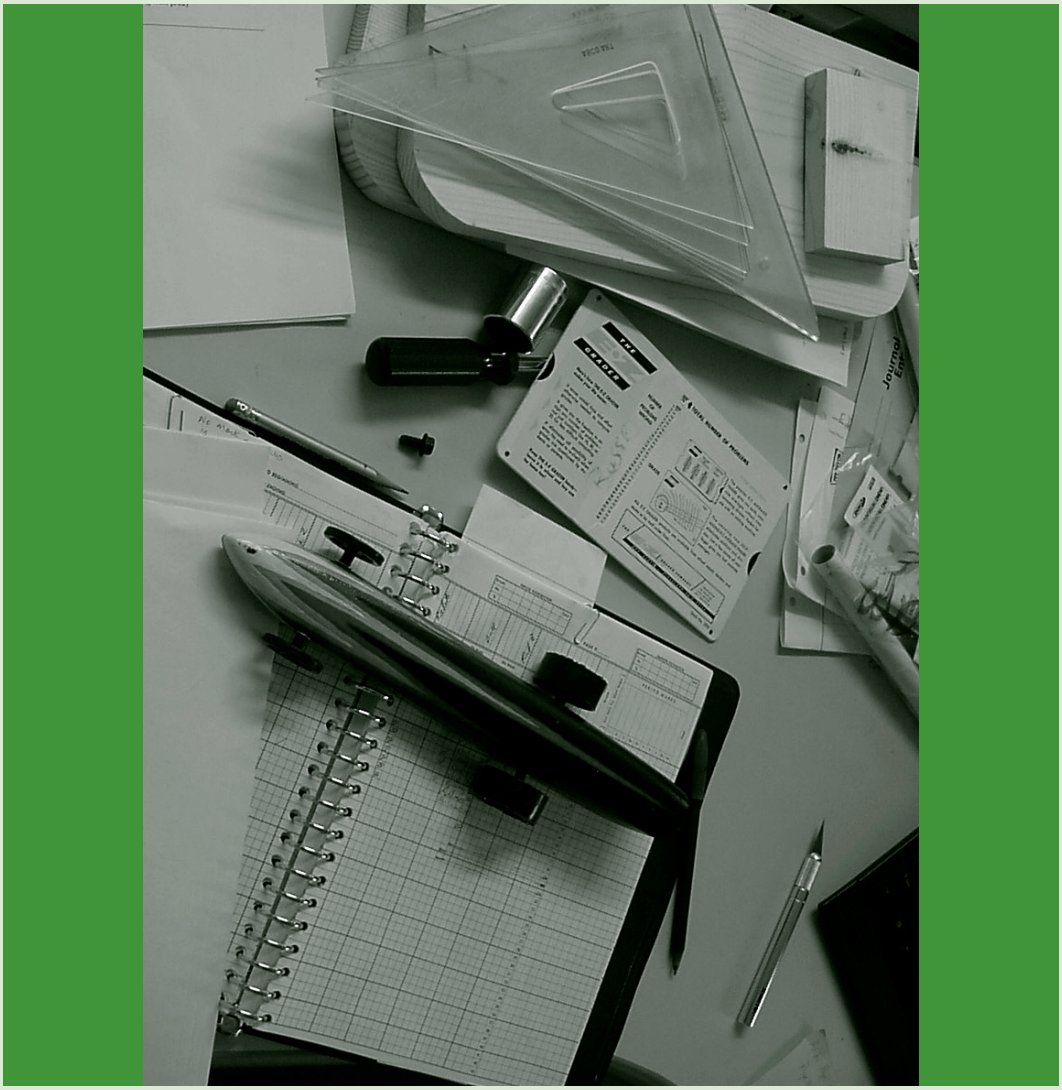
The Next Step: Realizing Standards-Based Programs

Standards-based technology program revision is unlikely to occur all at once. In some ways, implementing an entirely new program based upon the standards will be much easier than revising an existing one. However, once the state, school district, or locality has committed to teaching technology based on the standards in *STL* and *AETL*, the improvements that occur will continue to prepare students for the technological world in which they will live. Program leaders will decide where to begin the change process based upon many specific considerations, including funding, opportunity, and motivated school personnel. The important thing is to begin *somewhere*, knowing that the rest will follow as the demand for technologically literate citizens reaches crucial levels. Even small beginnings will help ensure that the students in individual states, districts, and localities will not be left behind the technological forefront of opportunity in their adult lives.

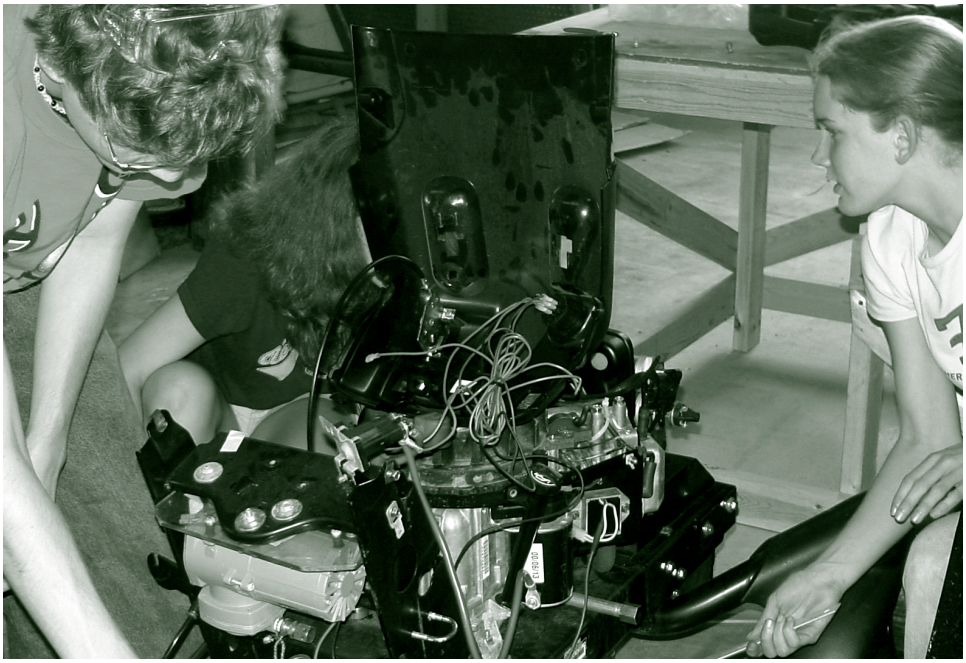
Even small beginnings will help ensure that students will not be left behind the technological forefront of opportunity in their adult lives.

SECTION 3

A Model Standards-Based Technology Program



This section describes the characteristics of standards-based technology programs and presents examples to highlight several of the characteristics.



Creating an articulated program requires: 1. Content that builds upon the knowledge and abilities encountered in previous learning experiences or grades (vertical articulation) and 2. Content that enables all students of a given grade to develop consistent knowledge and abilities (horizontal articulation).

Creating an integrated program requires that content highlight the connections between technology and other fields of study.

It is not appropriate to suggest that a "one size fits all" model to standards-based technology programs exists. Rather, programs are designed to meet the needs of the students and communities that they serve. There are, however, several features or characteristics that are common to every standards-based technology program. Technological study advances students toward technological literacy. Cognitive knowledge and learning activities promote an understanding of technologies (i.e., medical, agricultural and related biotechnologies, energy and power, information and communication, transportation, manufacturing, and construction). Students examine issues from multiple perspectives and solve practical, real-world problems relevant to the concerns of society. Students develop understandings and abilities that enable them to "make sense" of the technological world and cope with technological change.

To fully understand the articulated and integrated study of technology within schools and school districts, users of *Realizing Excellence* will want to consider the big picture perspective. As Zark VanZandt and Jo Hayslip suggest, "seeing the big picture means having a broad view of the total undertaking, and it is fundamental to creating and maintaining a program that is truly comprehensive and developmental" (2001, p. 33). Ideally, within each K–12 technology program, there also exists an elementary technology program, a middle school technology program, and a high school technology program. In elementary school, technological study is thematic and is experienced at all grades by all students. At each grade from 6–12, there is at least one course. Within each course, there are units. And within each unit there are lessons. All of these levels of the program are based upon technological literacy standards and are required for all students.

Characteristics of a Model Technology Program

This section of *Realizing Excellence* does not present a step-by-step process. Instead, this section describes the essential characteristics of a standards-based technology program. The identified characteristics provide a "snap-shot" of a standards-based technology program. **The characteristics are NOT intended to shorten or substitute for the entirety of "Program Standards" in *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*** (*AETL*) (ITEA, 2003); rather the characteristics should be considered in conjunction with "Program Standards." They are being presented to provide a picture of what a standards-based program looks like.

The identified characteristics of a model standards-based program provide a "snap-shot" of the technology program. The characteristics are NOT intended to shorten or substitute for the entirety of "Program Standards" in *AETL*; rather the characteristics should be considered in conjunction with "Program Standards."

A standards-based technology program incorporates:

- Technological Literacy Standards
- Authentic Learning
- Equity
- Appeal for All Students
- Articulation Across Grade Levels
- Integration Across Disciplines
- Professional Learning Communities
- Business and Community Collaborations
- Current Research
- Flexibility / Capacity for Revision
- Accountability to Stakeholders
- Visibility

The descriptions that follow depict the current state of a standards-based program that exemplifies these characteristics. Teacher stories are inserted to further describe certain characteristics in action.

Technological Literacy Standards

Standards-based programs start with standards. Standards are not used as a checklist but provide the fundamental ingredients for technology programs. Educators look to educational standards for direction in building the study of technology into every classroom. For example, *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002) provides the content base upon which professional development, curricula, instruction, student assessment, and the learning environment are built. *AETL* describes the manner in which program components are applied.

Standards-based programs start with standards. This includes *STL* and *AETL* as well as state/regional/provincial, school district, and school technological literacy standards and other content area standards.

Documentation (e.g., Appendix G) is available detailing the content standards that are being taught and assessed. All of the *STL* standards and benchmarks within each grade "band" (i.e., K–2, 3–5, 6–8, or 9–12) are addressed at increasing levels of complexity each time the content is encountered.

Authentic Learning

Student learning is the center of the technology program. Therefore, content, professional development, curricula, instruction, student assessment, and the learning environment are coordinated to ensure effective student learning. Teachers provide learning opportunities that resemble practical experiences and require students to demonstrate understanding through hands-on, minds-on activity. Teachers further require that students reflect upon their work, helping them to distinguish between the choices they made based upon personal preferences or values and the decisions they made based upon content knowledge. Authentic learning attempts to replicate life outside the classroom.

Teacher Story

Building a Technology Education Program
In Engineering Design for the High School

Shelly Montgomery

This teacher story highlights the following characteristics of standards-based technology programs:

- *Authentic Learning*
- *Appeal for All Students*
- *Integration Across Disciplines*
- *Flexibility / Capacity for Revision*

I live and teach in the same school district in which I was born and raised. After establishing a successful CAD program, our district witnessed one industrial arts program after another closing down with none to replace them. Realizing the importance of technological literacy and how it enhances the manual skills that were being taught, I began to re-build my program by focusing on several aspects that needed a great deal of attention. First, the focus was on a curriculum that would meet the needs of students and excite them. Second, the facilities needed to be consistent with those of a first-class technology education program. And third, the program needed to be promoted to attract sufficient enrollment to justify it in the minds of the administration. Nine years later, the technology education program in engineering design entices students into the engineering profession and helps build the base they need for their freshman year of college.

Five years ago, the principal of another high school asked me to design a state-of-the-art technology education engineering laboratory for their school. The traditional industrial arts program had once been a powerhouse in the district, but there was nothing left of it in any form. The woodworking lab was being utilized by another organization, the drafting room was long gone, but the metals lab was still struggling along.

Naturally the first step was to figure out what direction would be best for the needs of all the students. At this time, *STL* was not yet released, but I knew that a standards-based curriculum was the only choice for putting this program in alignment with mathematics and science. The program was already effective in building self-esteem, pride, and self-determination, but it needed to go a step higher. I based the program on the Texas Essential Knowledge and Skills (our state standards), and it has evolved from a couple of courses into a comprehensive technology education pre-engineering program. It is a natural crosswalk for cross-curricular instruction. When *STL* was released, the standards provided additional direction to prepare students for their futures as technologically literate citizens.

Plans were drawn up and approved, and construction was completed; technology education had come back to Memorial High School. The students were attracted to the program by the excitement

the staff and administration demonstrated. The metals lab, which was nearly a ghost town, is now swarming with kids building things and figuring out how to make them work. It is an exciting place.

It seems everything makes a complete circle. I had to be willing to scrap what was comfortable in order to have a program that is fresh and in alignment with *STL* and other national standards. It was not a coat of paint but a true revitalization from the inside out. It is painful to state that the old industrial arts is gone, but it is. It is not important where I am in regards to retirement, or how much time I have left. What is important is what I am doing for my students today for their futures. We need to consider whether we are just teaching a skill or whether we are teaching students how to think, solve problems, and make mathematics and science come alive. For our profession, I fear our programs will continue to shut down one by one unless we build something that can last for the next generation.

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Equity

The technology program provides students with equal educational opportunities that are challenging. All students have access to the study of technology. All students benefit from the offerings of the technology program. Students are able to succeed on equal terms regardless of interests, cultures, abilities, socio-economic backgrounds, or special needs (Garcia, 1998). Teachers incorporate student commonality and diversity in a manner that enriches learning and empowers students. Students are empowered "…to think for themselves; to construct knowledge, or meaning; and to learn respect for themselves and others" (Garcia, 1998, p. 51).

Appeal for All Students

The study of technology appeals to all students by addressing a variety of student interests. Care is taken to select technological content that entices all students regardless of gender, culture, abilities, socio-economic backgrounds, or special needs. Technological study is motivating to all students. That is, students are interested in and motivated to participate in technology coursework because the program provides an environment that satisfies the needs of all learners. The program is marketed to "non-traditional" students. Non-traditional students experience success in the classroom and are eager to participate in the offerings of the program.

Teacher Story

Children's Designing and Engineering Lab for Elementary School

Janis Detamore

This teacher story highlights the following characteristics of standards-based technology programs:

- *Equity*
- *Appeal for All Students*
- *Accountability to Stakeholders*
- *Visibility*

The idea for our Children's Designing and Engineering Lab came after 15 of our teachers participated in a class from the College of New Jersey. Those of us who worked through this class actually got to be builders and designers. We were trained to provide hands-on, inquiry-based, cross-curricular teaching. We caught an enthusiasm for learning the concepts because we were doing it ourselves. We took that excitement back into our own classrooms. The class helped us to integrate the practice of design and technology education into the units of study that are tied to our Virginia Standards of Learning. We wanted to take what we had learned and help our students bring relevance and meaning to their own learning by becoming engineers themselves. For example, our fifth grade teachers wanted to teach a year-long unit entitled "Submerged in Learning." The focus of the unit would be transportation technology, and students would create and design model submarines. Throughout the year, students would add devices that demonstrated their learning of the fifth grade technology and science standards.

I wrote a grant proposal to purchase a technology cart that allowed for design and technology activities to take place in K–5 classrooms. One of the problems we continually encountered when completing design and technology activities was that there always seemed to be a shortage of materials or tools. With the cart, many more students would be able to participate in design and technology learning. My goals for the project were to:

- Continue giving students opportunities to design and build;
- Make learning educational standards meaningful and relevant to students' lives;
- Give those students who struggle in other content areas an alternate route to success;
- Help students experience accomplishments and build confidence; and
- Encourage other teachers to try this type of teaching.

The project was approved, and the technology cart was purchased. The cart is housed in my classroom, and other teachers can sign materials and tools out. Many activities have been conducted in the K–5 classrooms in our school using this cart. Just in my classroom alone, we have built the "perfect chair," an "information station," the Parthenon, an aqueduct, the Coliseum, a

"marvelous machine," and battery-operated vehicles for our Shenandoah National Park Day. The project served our entire school, which includes 400+ students.

There are numerous benefits to having this lab for our school. I think that the most important benefit is the fact that students become actively engaged in their learning and become better problem solvers. The teachers are able to be innovative and allow the students to do their own research and discovery. This inquiry-based learning allows for confidence to grow within students who may experience difficulties in other academic areas in school. I had a student last year who had Asperger's disorder.[2] He absolutely shined during our project times. The other students went to him with questions about how to design their projects, and when he shared his design, I could hear the pride in his voice from a job well done. The other important aspect of design and technology is that teachers in any school, at any grade level, can apply it in their classrooms. I have found that language and mathematics instruction can be integrated with these projects. One of the important parts of this strategy is the final "sharing" stage. We have shared with younger students, older students, parents, and the community when we finish our projects. This not only gives the students practice in public speaking, but it also helps their retention of the materials when they have to explain their work and end result. I have also seen the benefits of a project failing a couple of times, until the student finally gets the project to work. This is when real learning takes place!!

With each project the students have portfolios that they develop to present their plans and learning. These include labeled, detailed plans for what they want to accomplish. The portfolios also end with a reflection component where the students tell what they liked and didn't like about the project and why. They also tell me what they would have done differently. The portfolios provide the measurable goals needed to show learning and growth. When the portfolios are shared with parents and others, as appropriate, they also increase the visibility of the technology program.

When we have adult visitors, they are always amazed at our accomplishments. A frequent comment is, "I wish I could have built things like this when I was in school." The cart was used during our "Family Fun Night," where mathematics and science activities were highlighted in classrooms. The room was jam packed!!! Many parents and children were seen problem solving and building together. It was truly amazing to watch. Some parents said, "I wish elementary school was like this when I was younger."

All of the original goals have been touched on, or met. This will be an ongoing process. The cart has helped to spark the interest of other teachers as well as the parents and students. There have been numerous examples of students being totally on task and making important decisions together. Some students did not want to go outside for recess because they wanted to finish something. This cart has been very successful in helping our school and the students. The

administration and community have seen the benefits of design and technology in the elementary school setting. We are fortunate to have their support!

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[2] Asperger's disorder is a developmental disorder that includes repetitive behavior and impaired social interactions. It is similar to the disorder known as autism.

Articulation Across Grade Levels

Technological study is sequenced across Grades K–12 so that learning occurs in an articulated fashion. The *technology program* extends from kindergarten through Grade 12 and incorporates the study of technology across grade levels as a core school subject that focuses on technology, innovation, design, and engineering. Technology teachers and administrators coordinate the technology program so that learning progresses from simple concepts in elementary school and advances to more sophisticated concepts through secondary school. Everything that is taught depends upon the previous learning experiences that students have had (including, for K–5 elementary students, experiences prior to formal education), while preparing them for future studies in technology.

Integration Across Disciplines

Teaching and learning in all content area classrooms are aligned with the technology program and with *STL*. In other words, the technology program extends across disciplines. In *AETL*, this is referred to as the "cross-curricular technology program." Technology teachers help other teachers coordinate instruction in all school subjects with technological literacy standards.

The attainment of technological literacy is perceived as a cross-curricular effort. Most content area teachers expect a minimum level of performance from their students in other core subject areas. For example, the science teacher expects his or her students to be able to write papers that use spelling and grammar appropriate to the grade level in which he or she is teaching. The study of technology is regarded in a similar manner. For example, a social studies teacher might investigate how technology influenced changes in social culture throughout history in his or her classroom, just as a science teacher might investigate the positive and negative impacts technology has had on global warming in his or her classroom. Technology is such a broad area of study that it impacts and is impacted by all other disciplines.

Professional Learning Communities

The school faculty recognizes the importance of technological literacy and shares the vision that all students should study technology. Teachers and administrators, across grade levels and disciplines, work together to ensure that all students study technology. Collaboration is essential to the success of the technology program, so time is provided during the school day for faculty to work together and engage in reflective dialogue. The technology program supports teachers as learners. Teachers of professional learning communities represent varied expertise. Rather than every individual in the professional learning community possessing consistent knowledge and abilities, every individual shares his or her own expertise with others, and the group builds on the collective strengths of its members.

Teacher Story*

Designing Technology Courses That Are Standards-Based

TfAAP Staff

This teacher story highlights the following characteristics of standards-based technology programs:

- *Technological Literacy Standards*
- *Integration Across Disciplines*
- *Articulation Across Grade Levels*
- *Current Research*

Ms. Lopez and Mr. Begay are technology education teachers at Wolf Middle School in Coconino County, Arizona. They decide that they want to transform the existing 6th, 7th, and 8th grade courses into a technology program that is based on *Standards for Technological Literacy: Content for the Study of Technology (STL)*(ITEA 2000/2002) and aligned with the program standards in *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards (AETL)* (ITEA, 2003). They want their program to be articulated, providing a seamless link from the local elementary school to the county high school. They feel very strongly that when students graduate from middle school, they should be able to start high school having engaged in well-planned and well-designed technological study. Ms. Lopez and Mr. Begay plan to work with the other teachers in the middle school to make cross-curricular connections so students see how technology and other fields of study relate. They have had an ongoing and functioning eight-member Advisory Committee for the past five years. It was, in fact, this Advisory Committee that suggested Ms. Lopez and Mr. Begay update their more traditional industrial arts program to make it standards-based and more reflective of the technological world.

Ms. Lopez, Mr. Begay, and the Advisory Committee agree that to transform the existing program into one that is standards-based will require that they start from scratch. To begin the process of developing a new program, Ms. Lopez and Mr. Begay formulate their own initial vision of the Technology Program at Wolf Middle School. They consult *Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA, 1996), *STL*, and *AETL*. The vision that all students at Wolf Middle School should become technologically literate becomes the basis for communication to others who need to be convinced that technological literacy is in the best interest of the students, the school, and the community. The vision becomes a valuable instrument for building support for change.

Ms. Lopez and Mr. Begay, with permission from their principal, form a Technology Program Committee which includes their school principal, a science teacher, and a parent who works for a local manufacturing industry. The Technology Program Committee works with Ms. Lopez and Mr. Begay to design the new program. Ms. Lopez serves as “chair” to the committee. The Technology

Program Committee plans to share its proceedings with the Advisory Committee. They also intend to seek input during the planning stages of program development from the Advisory Committee at its regularly scheduled meetings.

The first meeting of the Technology Program Committee is held in the fall of the year, once school has started. It is an organizational meeting, and they develop a mission statement for the technology program [see pages 40–41]. In their second meeting, they develop program goals and strategies [see pages 42–44]. Next, they decide that it is important to gain administrative approval for establishing a standards-based technology program. Since the principal is on the Technology Program Committee, he agrees to accompany Ms. Lopez and Mr. Begay to meet with the county school superintendent to inform her of the progress thus far and to gain her approval to proceed with revising the technology program. The Technology Program Committee also sets up meetings with the principals and some teachers at the feeder elementary schools as well as the county high school. Last but not least, the Technology Program Committee establishes a time to meet with the middle and high school guidance coordinators. It is hoped that these meetings will enable the Technology Program Committee to establish an articulated plan for a comprehensive K–12 technology program in Coconino County.

The Technology Program Committee next examines the standards in *STL* and groups them in such a way to establish organizing principles for three technology courses at Wolf Middle School. The technology teachers, Ms. Lopez and Mr. Begay, state that the first course offered in the technology program (at Grade 6) should be broad in scope and should present content that is exploratory in nature. They additionally suggest that the seventh and eighth grade courses should have more in-depth content with more academic rigor. The Technology Program Committee spends considerable time researching *STL* to determine the content for the three courses. The topics of design, innovation, and systems seem to be very important concepts in *STL*, so they use these as organizing principles for courses [see pp. 45–47]. The Technology Program Committee agree on three tentative course titles to be:

6th Grade: Exploring Technology (6–36 weeks)
7th Grade: Innovation and Engineering Design (18–36 weeks)
8th Grade: Technological Systems (18–36 weeks)

The Technology Program Committee plots a responsibility matrix indicating how much each of the three middle school courses will cover the content standards to adequately address each of the 20 *STL* standards. Figure 2 portrays the Technology Program Committee's responsibility matrix. [Appendix G is a blank Responsibility Matrix Form.]

After developing a content (responsibility) matrix for the three planned courses, the Technology Program Committee go to the benchmark level and determine more specifically what should be in

Figure 2. Wolf Middle School's Plan for Standards Coverage

Responsibility Matrix Form Page 1

Directions: Page 1 of this form should be used to indicate which standards in *Standards for Technological Literacy* (*STL*) will be addressed at each grade level of the technology program. Fill in this form using "X" to indicate maximum coverage, "√" to indicate moderate coverage, and "O" to indicate minimal coverage.

***STL* Standards**	***STL* Coverage in the Technology Program**												
	Elementary Classrooms						Technology Laboratory-Classrooms						
	K	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
***STL* 1.** Students will develop an understanding of the characteristics and scope of technology.							x	√	0				
***STL* 2.** Students will develop an understanding of the core concepts of technology.							x	0	√				
***STL* 3.** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.							√	0	x				
***STL* 4.** Students will develop an understanding of the cultural, social, economic, and political effects of technology.							x	0	√				
***STL* 5.** Students will develop an understanding of the effects of technology on the environment.							x	√	0				
***STL* 6.** Students will develop an understanding of the role of society in the development and use of technology.							x	√	0				
***STL* 7.** Students will develop an understanding of the influence of technology on history.							x	0	√				
***STL* 8.** Students will develop an understanding of the attributes of design.							√	0	x				
***STL* 9.** Students will develop an understanding of engineering design.							√	x	0				
***STL* 10.** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.							√	x	0				
***STL* 11.** Students will develop the abilities to apply the design process.							√	x	0				
***STL* 12.** Students will develop the abilities to use and maintain technological products and systems.							√	0	x				
***STL* 13.** Students will develop the abilities to assess the impact of products and systems.							√	0	x				
***STL* 14.** Students will develop an understanding of and be able to select and use medical technologies.							√	0	x				
***STL* 15.** Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.							√	0	x				
***STL* 16.** Students will develop an understanding of and be able to select and use energy and power technologies.							√	x	0				
***STL* 17.** Students will develop an understanding of and be able to select and use information and communication technologies.							√	x	0				
***STL* 18.** Students will develop an understanding of and be able to select and use transportation technologies.							√	x	0				
***STL* 19.** Students will develop an understanding of and be able to select and use manufacturing technologies.							√	0	x				
***STL* 20.** Students will develop an understanding of and be able to select and use construction technologies.							√	x	0				

the content of the three courses. The committee members realize that all 20 *STL* standards and their respective benchmarks for Grade Band 6-8 should be covered over the three-course middle school program. They acknowledge that Ms. Lopez and Mr. Begay could add to the existing benchmarks if they want to augment or provide further richness to the existing content (as established in the benchmarks).

After completing this identification of courses and levels of coverage of the *STL* standards and benchmarks, the Technology Program Committee goes through a similar planning process to identify which standards from other school content areas (i.e., *National Science Education Standards, Principals and Standards for School Mathematics*, Project 2061 *Benchmarks*, etc.) they want to incorporate in the three middle school courses.

The Technology Program Committee then works with other content areas in the school program and develops a matrix for other school courses to offer content that would contribute to the technological literacy of all students. They receive input from teachers in mathematics, science, social studies, language arts, agriculture, health sciences, music, and art.

Finally, the Technology Program Committee establishes an action plan [see Appendix H] for the study of technology at Wolf Middle School. They are successful in obtaining funding from the county school board. Also, many businesses and industries in the county give their support for the new middle school technology program. In retrospect, Ms. Lopez and Mr. Begay are very pleased with the results of the Technology Program Committee planning and vision. All the students at Wolf Middle School are very excited about the new, contemporary offerings in technology at their school. Parents are supportive of the efforts to bring a new middle school technology education program to their rural area. The school administration is pleased with the enrollment and interest in the technology classes.

Technology for All Americans Project staff can be reached at standards@itea-tfaap.org.

** This "teacher story" is a theoretical representation of the characteristics described in Section 3 and the actions described in Section 4 of Realizing Excellence.*

Business and Community Collaborations

Educators create opportunities for local businesses and members of the community to become involved with the technology program. Business and community participation might include involvement in an advisory committee, material or resource support, and advocacy for the study of technology, among other things.

Current Research

Classroom practices are research-based. Teachers remain current with research on technology, teaching, and learning, and classroom practices reflect such research. Curricula, instruction, student assessment, and the learning environment are frequently revised to reflect current information available about technological literacy learning. Teachers view their classrooms as a source for data about the learning of technology. They understand the need for additional research on students as learners of technology and are willing to share the data resulting from any action research conducted in their classrooms.

Flexibility / Capacity for Revision

Technology content, professional development, curricula, instruction, student assessment, and learning environments are *not* rigid. Program component design enables revision to occur as necessary to reflect:

- The dynamic, changing nature of technology.
- The changing needs of the students and community.
- Research on teaching, learning, and assessment.

Accountability to Stakeholders

Educators monitor program effectiveness and report successes as well as setbacks to program stakeholders. Educators gather evidence from many sources using a variety of methods to ensure valid and reliable data collection. Program evaluation data allow educators to report on the condition of the technology program. Technological literacy standards provide the basis for evaluation. Evidence is gathered to determine the extent to which programs are successfully serving K–12 students. The results of evaluation are used to make professional development and program enhancement decisions.

". . . *validity* focuses on the accuracy or truth of the information (data) collected . . . while reliability attempts to answer concerns about the consistency of the information (data) collected." (ITEA, 2003, p. 23).

Visibility

The study of technology is promoted through a planned marketing campaign. Program stakeholders promote technology programs and technological literacy as essential components of education to students, parents, the community, and business and industry through public awareness initiatives. Technological study is recognized within schools and schools districts as necessary for developing technological literacy, which is beyond computer literacy. The difference between technology education and educational technology is made clear.

Teacher Story

A Collaborative Approach to Building Technology Programs

Terry Price and Teri Tsosie

This teacher story highlights the following characteristics of standards-based technology programs:

- *Articulation Across Grade Levels*
- *Business and Community Collaborations*
- *Professional Learning Communities*
- *Visibility*

Our story begins with a handful of middle school technology education teachers who decided it would be pretty cool to "share the wealth" and have technology education taught in elementary school. Of course these characters were thinking of themselves and how their programs would be greatly improved if only students came to them just a little more prepared. So they began searching for grants to pay for their efforts to write worthwhile elementary units that were hands-on, easy to follow, integrated into existing curriculum, and standards-based. Then they would turn around and train elementary teachers to integrate these units into their curricula. The objective was to help elementary teachers understand technology education and how it could be integrated into their classrooms. The caveat was that elementary teachers would receive all materials needed to complete the activities in their classrooms. This meant purchasing drills, miter boxes, wood supplies, and plastics—whatever it took.

The middle school technology group struck gold, and the grants came in. Four small grants from four different local businesses were obtained. A team of educators ranging from elementary school to college gathered to work on this endeavor. The group decided to select four different areas of technological study: manufacturing, electronics, transportation, and plastics. A meeting of the minds was set to bring everyone up to speed on the standards in *STL*, which were developed by ITEA's Technology for All Americans Project. We reviewed the California technology education state standards. We discussed grade level appropriateness and core curriculum state standards. A game plan was laid out, and teams were formed to accomplish our goals. The group decided on a format and the types of activities. We were off and running.

Not everything ran smoothly. Our diverse team found themselves frustrated after the first day, agreeing and disagreeing on the capabilities of the younger learner. Question after question arose. How appropriate were the activities for each age group? Would teachers be able to teach the activities as presented? How would students be assessed on each activity? The format that was agreed upon in the early stages was evolving into something more complex. At one point we all looked at each other and asked ourselves what we had gotten ourselves into. As the stress levels grew, we all stopped and took a step back to regroup. This was no easy task. We started the ideas flowing again, and strategies started to unfold on how to conquer our mission. Our end result was four technology units that were cohesive, standards-based, used problem-solving techniques,

assessed students, and gave the elementary teacher enough background information to teach each unit. We had accomplished the first step.

Step two was pilot testing these technology units and training the elementary teachers. We sent flyers out to the greater Los Angeles area. We targeted numerous elementary schools and set up workshops. We had very few takers. We were offering *free* workshops with *free* supplies for use in the classroom, but we could not get elementary teachers to commit to taking one workshop. Once again we had to step back and take a good look. The problem was not our curricula. The problem was that no one understood what we were offering. What was technology education? How did it fit into the already crowded curriculum that the elementary teachers had demanded from them by the state? Why would they want the training? These were among the many questions that were asked of the group. Training strategies went into place. Each team member targeted a few elementary teachers in their district and coerced them to attend one workshop. We thought that if we could get a few teachers to test the curriculum, others would see what they were doing and want to take part.

Our first workshop was held at California State University, Los Angeles. The seminar started with a brief overview of transportation technology, a layout of the unit, an overview of state and national technological literacy standards, and then moved right into the hands-on activities. As each activity was discussed, more and more aspects of the integration of technology education were brought into the discussion. The teachers being trained were amazed at what they had completed. They became even more excited when they realized that they got to take all of the supplies they were using back to their schools. Comments like, “Wow, I always wanted to play with tools,” or, “We get to keep everything? I always wanted a few hammers in my classroom,” and even, “Why didn't someone come up with a program like this when I was in school? It all seems to fit right into our curriculum.” We sat back and smiled. We were able to deliver what we had set forth to accomplish. The trainers were thrilled. The first group of elementary teacher training was a success!

During our first year, we presented four all-day Saturday workshops. We called them “Elementary Boot Camps.” Each had its own theme, such as transportation technology and manufacturing technology. The workshops took place in middle schools, community colleges, and universities. This allowed the elementary teachers to be exposed to technology education, as their students would, in a middle school, high school, and college setting. We followed each workshop with a letter, and photographs were sent to each of the companies that sponsored the grants to inform them of our successes.

To increase the visibility of our project, workshops were given during our state conference, with our trainees presenting what they had learned and how they incorporated technology education into their classrooms. The first time some of our elementary teachers gave a presentation during our state conference, they were nervous and worried because very few elementary people were in attendance. The first session they gave was to a room full of middle and high school technology teachers and one superintendent. When it was all over, the session was the talk of the conference. The trainees were asked to present workshops in other school districts throughout the state,

allowing other elementary teachers to be brought up to speed. During the second year, some of the activities were rewritten, and more and more teachers were trained. Our visibility and our success were growing.

Step three was the education of the administration so that they could fully understand and support what was taking place in the elementary classrooms. Most administrators understand the word technology as being a computer, but of course we knew there was more to it than that. Gaining support for our programs in the state of California was not an easy task. For example, one school district belongs to a Consortium which includes thirteen school districts, three community colleges, four universities, and numerous businesses in and around the communities. The Consortium has four leadership meetings each year where all superintendents, administration, school board members, and business personnel are invited. As a guest speaker invited to talk on a specific technological topic, one member of our group presented: Technology Education vs. Educational Technology: What's the Difference?

Next, we invited one of the key leaders in the state to come and speak to our Consortium members. We had a big advantage in that so many of the companies in our communities deal with one or more aspects of the very technologies we were teaching. Most of our parents are employed by aerospace, plastics manufacturing, Hollywood, car manufacturing, and design companies-and more. Numerous business personnel, who are Consortium members, worked for these types of companies. Several of our business leaders stood up at the meeting and said they never realized that technology education was taught during the early years in our school districts. Some didn't know technology education existed in the schools at all. They became our number one cheerleaders. We invited them to attend an Elementary Boot Camp or participate in an elementary classroom activity. Our superintendent was among the first to take us up on the offer. He became a team member in one of the manufacturing companies that was set up in a fourth grade classroom. He manufactured cookies with his team members and designed packaging for their product. When the initial pilot project came to conclusion, it was midway through the school year. Our superintendent kept that package of cookies in his office all year to share his experience on the production line with others. This third step was crucial to our very existence. If the administration and the community are educated about what is taking place in the schools, support is not far behind.

Our final step was to maintain and upgrade our programs. Through the process of training our elementary teachers, we gained a great deal of knowledge. Education of our administration to fully understand the impacts and roles technology education plays in our schools was a key component. Now, each year we apply for grants within our communities to maintain or upgrade our technology education programs. Unfortunately, the state of California is in such a deficit that our mere existence as educators is in jeopardy. Even so, we have been able to build a very successful integration of technology education within our schools by maintaining high visibility and soliciting business and community support. Engaging elementary teachers in the arena of technology education took us about three or four years to accomplish. It did not happen overnight. The

dedication and leadership contributed by those already teaching technology education in middle schools, high schools, and colleges helped a great deal.

We are clearly on the road to success. During the past two years our elementary teachers were asked to author yet another Elementary Boot Camp in the area of Communication Technology. Yes, those first teachers who had to be lured into the technology education pilot test have now become the authors and leaders of subsequent units. Much of our success can be credited to our community, which embraces the teaching of technology, and to the community leaders who understand the need and support the programs in which we engage our students. Not to mention that small group of middle school teachers who started the ball rolling.

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Leadership for the Study of Technology

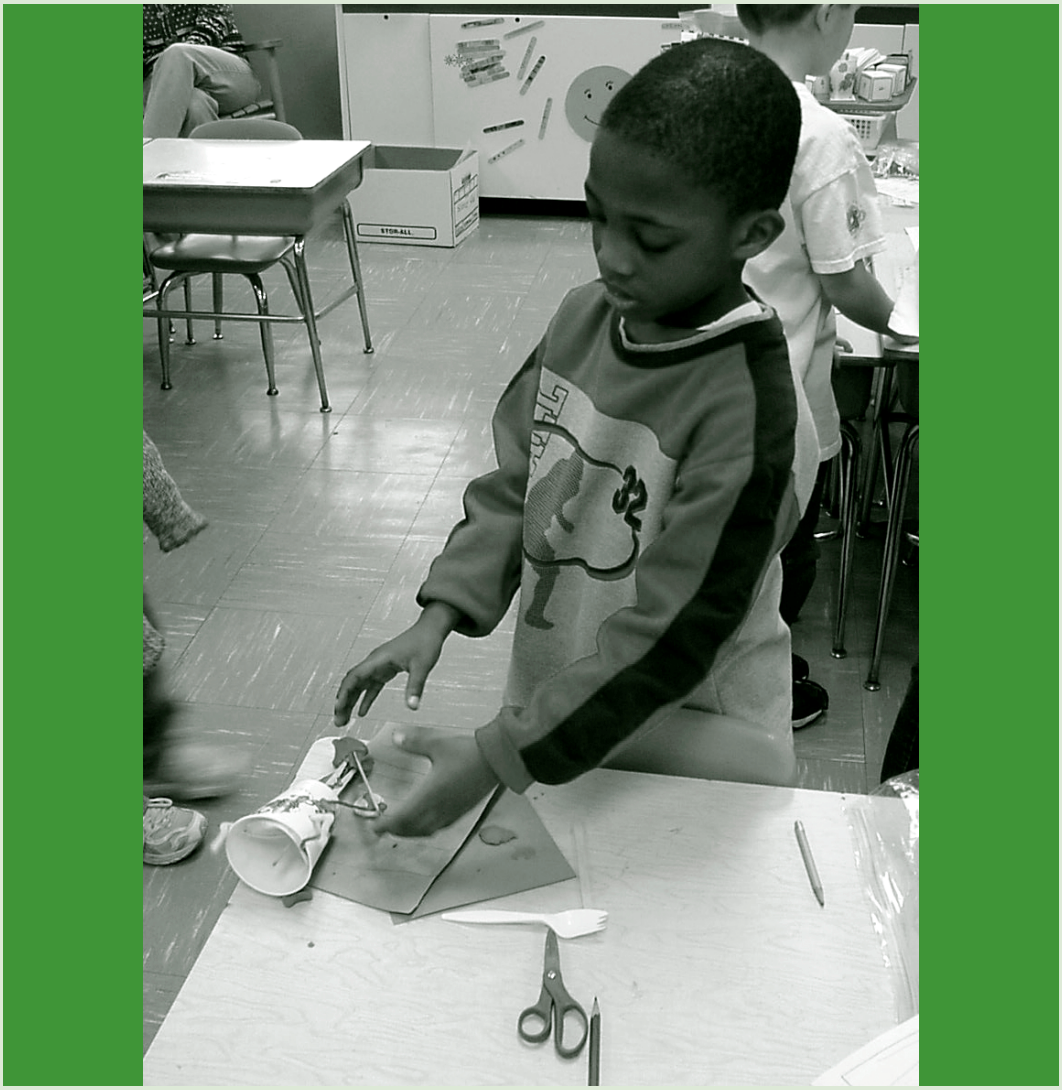
Technology teachers across the United States are working together with administrators and other teachers to create school environments that enable students to attain technological literacy. In the preceding stories, educators highlighted their experiences by describing the efforts they made and continue to make to ensure that all students are encouraged to study technology across Grades K–12. These stories are just a few examples of the successes being achieved every day by educators in the field. These teachers and administrators recognize that what is accomplished in the individual laboratory-classroom cannot exist in isolation. They know that for technology programs to be effective and successful, they must maintain high visibility and incorporate the rich resources gained through business and community collaborations.

All those who believe in the vision of technological literacy for all students share a responsibility to make the vision a reality. By remaining informed of current research and keeping programs flexible to enable necessary changes that reflect such research, all those responsible for the program can remain accountable to others who are stakeholders in the successes of students.

The goals set forth in *Realizing Excellence* are not going to be easy; but with the dedication of those willing to stand up and become leaders for technological literacy in every school in the Nation, they are obtainable. And the results will be invaluable to students and society as a whole.

SECTION 4

Structuring Standards-Based Technology Programs



This section provides direction to technology program leaders as they strategically plan the study of technology for their schools and school districts.

This section provides direction for program leaders in establishing articulated and integrated technology programs and aligning the study of technology with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA 2000/2002) and *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003) *(*AETL *Program Standard 5, Guideline I)*. While the suggestions apply to programs in any school or school district, the actions that users of *Realizing Excellence* take will be specific to their own localities. As Linda Lambert explains in her 1998 publication, *Building Leadership Capacity in Schools*:

> Your district may already be taking some of these actions; others will need your explicit attention. Use these guidelines to help you decide where and how to proceed . . . . Keep in mind that these guidelines are systemic. That is, they are connected in such a way that they form a dynamic relationship to each other and to the set. (p. 76)

Actions for Realizing Standards-Based Programs

Technology program planning must involve action. Program leaders should focus on the actions they will take to design standards-based programs. As planning and implementation occurs, program leaders will likely encounter setbacks and frustrations. It is important to focus on the "can dos," remembering that small steps are certainly better than no progress at all. Ideally, the planning process will involve technology teachers, other content area teachers, students, parents, administrators, and the community. While some of these actions may vary, as explained by Linda Lambert in the quote above, many will apply to all or most standards-based programs. Table 3 highlights the actions that program leaders can take in revising or developing standards-based technology programs.

Note: Appendix H is a workbook providing forms that technology program leaders can use as they design and document their technology program. Users can photocopy this workbook and fill it in as they complete the actions suggested in this section of *Realizing Excellence*.

Table 3. Actions for Establishing Standards-Based Technology Programs

Initial Planning
- Consider the standards in *STL*, then consider the benchmarks.
- Consider the five dimensions of technological study defined by *STL*.

Solicit Program Support
- Articulate an initial vision.
- Form committee(s).

Lay the Groundwork
- Develop a technology program mission statement.
- Establish long-term goals.
- Establish strategies for goals.
- Establish organizing principles.
- Write a program statement.
- Solicit approval.

Structure the Technology Program
- Identify and document courses.
- Establish an action plan.
- Develop a budget.

Secure Resources
- Obtain funding.
- Access laboratory-classrooms.

Implement, Monitor, and Adjust
- Establish and utilize a management system.
- Provide in-service and hire teachers.
- Allocate funds and other resources.
- Schedule courses and recruit students.
- Market and promote the study of technology.

Evaluate and Revise (see Section 5)

**Note: While these actions are listed in a linear order, establishing a program is far from linear. It is iterative, and actions will be revisited as needed. For example, ideally the standards and benchmarks in* STL *should be consulted prior to every action taken. Likewise, the standards and guidelines in* AETL *should be consulted.*

Initial Planning

The process of change can begin with one individual or several individuals acting together or independently. In any case, establishing a standards-based technology program must begin with the technology content standards in *STL*.

Consider the Standards in* STL*, Then Consider the Benchmarks. The standards should be the primary organizing and driving factors that initiate actions for establishing technology programs. The benchmarks provide further detail to the standards and should be considered after the standards are synthesized by the leaders who undertake the initial program planning.

***Consider the Five Dimensions of Technological Study Defined by* STL**. The 20 standards in *STL* are separated into five dimensions. They are:

- The Nature of Society
- Technology and Society
- Design
- Abilities for a Technological World
- The Designed World

It is vital that the leaders responsible for initiating technology program development or revision become familiar with the scope of these five dimensions of technology. This can be accomplished by close examinations of *STL* and the individual standards and benchmarks.

Solicit Program Support

The teacher is the most important component affecting the quality of technology programs. Yet, the technology program is much bigger than any one teacher. Achieving standards-based reform of technology programs requires the cooperation of teachers, students, parents, administrators, and the community. Ideally, all concerned constituents will work through the planning process together. This should be accomplished by developing structures that allow stakeholders to provide input.

***Articulate an Initial Vision*.** The success of the technology program will depend upon building support for the study of technology across grade levels and disciplines. As Reeves (2002) suggests, "systematic change rarely occurs as the result of an order, a resolution, or a policy. Rather change in a complex system occurs when the various key decision makers … decide that the new initiative is in their best interest" (pp. 118–119). Technology program leadership will need to convince teachers, students, parents, administrators, and the community that technological literacy is in the best interest of student futures. Articulating an initial vision for the

technology program will provide leaders with a tool to use for building program support. The initial vision should help expand the leadership capacity of the technology program and establish "buy-in." After all, making technological literacy a reality requires a strong system of support for content, student assessment, professional development, and programs (ITEA, 2003, p. 98).

Articulating an Initial Vision

1. Consider the technology program's potential for advancing student technological literacy.
2. Consider the purpose of the technology program. The purpose should incorporate why technological literacy is important to the community in which the program serves and society in general.
3. **Record the technology program's initial vision in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**

Form Committee(s). *Realizing Excellence* suggests that technology program leaders organize two committees to provide a system of "checks and balances" for the technology program. While the Technology Program Committee is involved in much of the initial decision making, having an Advisory Committee ensures that broader societal concerns are addressed as the program is planned and implemented. **In some situations, however, it may be more practical to have a single committee that serves in both capacities.** In such instances, users must ensure a broad base of representation by committee members (i.e., teachers, students, parents, administrators, guidance counselors, community members, and business and industry representatives, among others).

Technology Program Committee. To design a technology program that serves the needs of the students and community, users of *Realizing Excellence* will want to ensure that all stakeholders provide input to those who make decisions about the program. This can be done through a Technology Program Committee. Technology program leaders are encouraged to invite school personnel, including technology teachers, other content area teachers, administrators, and guidance counselors, to join them in serving on the Committee. Student, parent, and

Realizing Excellence **suggests that technology program leaders organize two committees to provide a system of "checks and balances" for the technology program: a Technology Program Committee and an Advisory Committee. In some situations, however, it may be more practical to have a single committee that serves in both capacities.**

community advice should be welcomed by the Committee. It is recommended that the Committee be relatively small and comprised of no more than five individuals.

The *Technology Program Committee* is a working group that establishes the focus and direction of the technology program.

The Technology Program Committee will answer several important questions about the program. Committee members will work together to identify what needs to be done to align the technology program with technological literacy standards. The Technology Program Committee will be involved in program development from planning through implementation to evaluation. Committee members will meet regularly to ensure that the needs and concerns of all students are addressed.

Forming a Technology Program Committee

1. Identify the technology teachers to serve on the Technology Program Committee. *
2. Identify other school personnel (including other content area teachers, administrators, and guidance counselors) to serve on the Technology Program Committee. *
3. It is recommended that the Technology Program Committee be comprised of no more than five individuals.
4. **Record the contact information for each of the Technology Program Committee members in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**
5. Determine a regular meeting time and location.
6. Program leaders should organize the planning meetings. Other Technology Program Committee members should provide input and assist program leaders in designing the technology program.

**Note: As the technology program should be articulated across grade levels, members of the Technology Program Committee should represent multiple grade levels.*

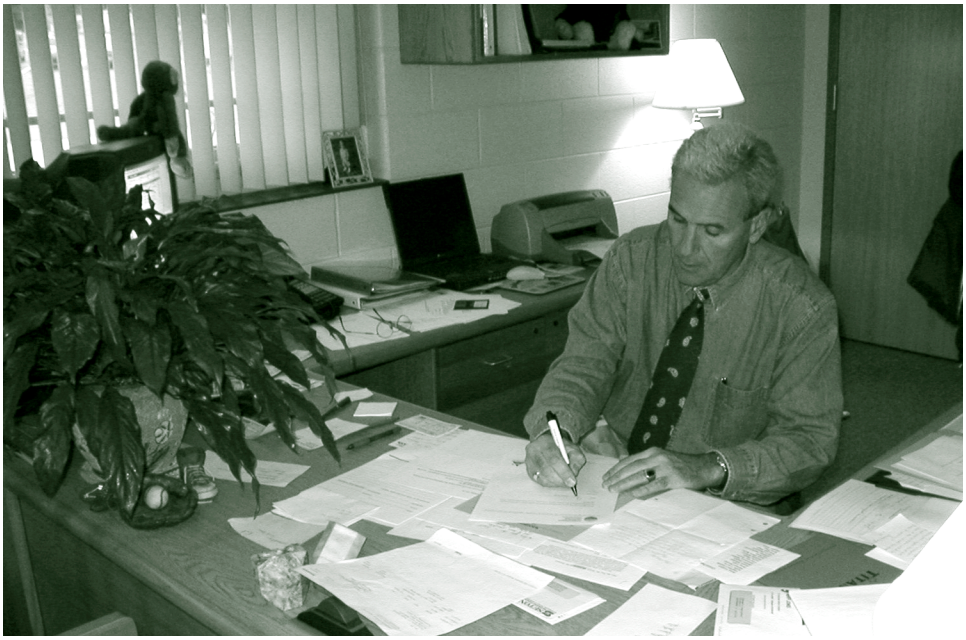
Technology Program Advisory Committee. A Technology Program Advisory Committee provides input to the Technology Program Committee throughout the development and implementation of the technology program to ensure that both school and community concerns are satisfied. An advisory committee is usually an ongoing and continuous committee and generally provides community representation and might include participation by parents, community members, local business and industry personnel, as well as college and/or university or trade school representatives. It is recommended that no more than eight individuals be asked to serve on the Advisory Committee.

The Technology Program Committee will need to determine the capacity to which it will involve its Advisory Committee in program decision making. The Advisory Committee may meet regularly to provide input (e.g., once a month or every two months) or simply as issues arise. The Advisory Committee may need to meet often during the initial phases of program enhancement.

A *Technology Program Advisory Committee* is usually an ongoing and continuous committee that oversees the technology program and assists the Technology Program Committee as it makes important decisions, ensuring that school and community concerns are addressed.

Organizing a Technology Program Advisory Committee

1. Identify a small and manageable number of individuals (no more than eight) to serve as the Technology Program Advisory Committee. Members should be selected carefully as it is necessary to represent different community constituencies. For example, parents, business and industry personnel, technologists, engineers, university faculty, former students, and retired professionals, among others.
2. Solicit the commitment of the selected individuals to serve on the Advisory Committee (see Appendix I for a sample letter).
3. **Record the contact information for each of the Technology Program Advisory Committee members in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**
4. Hold regular Advisory Committee meetings or meet as issues arise that demand input or consensus.
5. Enable committee members to provide input, not merely "rubber stamp" something that has already been finalized.



Lay the Groundwork

Effective student learning requires the coordination of all technology program elements, including content, professional development, curricula, instruction, student assessment, and the learning environment. Such coordination is possible as the Technology Program Committee expands the initial vision of the technology program and agrees upon the overarching aim and direction for the program. *Laying the groundwork* will provide the documentation necessary to receive initial approval, and perhaps necessary start-up funds or other resources, from administrative decision makers.

Develop a Technology Program Mission Statement. A good place to begin laying the groundwork is by examining the technology program mission statement. "[The mission statement] is a concise yet profound statement that encompasses the major philosophical beliefs underlying the program's operation and the school's aspirations for students who participate in the services and interventions that are offered by the program" (VanZandt & Hayslip, 2001, p. 69). In other words, the program mission statement defines "where we want to go."

Does the program have a mission statement? If so, does it define whom the program will serve, what services the program will provide, and how the program will provide such services (Daugherty, 2000)? Does the mission statement align with the vision of *STL* and *AETL*? If not, the Technology Program Committee should revise it. If the program does not have a mission statement, one should be developed.

The technology program mission statement goes beyond a definition of the program. It incorporates the overarching vision of what the community believes about technological literacy and its importance (i.e., that technology literacy is necessary for responsible and productive participation in a global economy). The mission statement clearly communicates the "who," "what," and "how" of the technology program by addressing why technological literacy is important in the community, while supporting existing school and school district structures.

Some things to consider when revising or developing a mission statement include:

- The mission statement should be established as a collective effort of program stakeholders. This should include the community outside the educational system: "Governance requires the establishment of specific structures that allow parents and community some voice in key school decisions" (Marzano, 2003, p. 48). The Advisory Committee is one "structure" that provides parents and the community, among others, a voice in building the program. Engaging the Advisory Committee in developing the mission statement will enable stakeholders to identify and clarify "…their values, beliefs, assumptions, and perceptions about what they [want] children to know and be able to do…" (Lambert, 1998, p. 6).
- It should explain the intent of the technology program by defining what will be accomplished.
- It is generally recommended that the mission statement be brief and not exceed five or six sentences (VanZandt & Hayslip, 2001).

An example of a mission statement follows:

> The technology program at Anytown Middle School is committed to providing technological study in a state-of-the-art facility, enabling all students to meet local, state, and national technological literacy standards. Technological study is required at sixth, seventh, and eighth grades. Students are prepared to engage in additional technological study in the high school years and beyond. Students will be prepared with knowledge and abilities to help them become informed, successful citizens who are able to make sense of the world in which they live. The technology program also enables students to take advantage of the technological resources in our local community.

Developing a Technology Program Mission Statement

1. **Fill in the mission statement section of the Structuring Standards-Based Technology Programs Workbook (see Appendix H) while considering the items that follow.**
2. Identify and clarify stakeholder values, beliefs, assumptions, and perceptions. This can be accomplished with participation from the Advisory Committee.
3. Review the philosophical foundation of the school or school district and state.
4. Consult *STL* and *AETL*.
5. Identify the unique features of technological study that complement the school's mission. How does this program serve the overarching vision of the school and community?
6. Work together to answer these questions:
   - Whom will the program serve?
   - What services will the program provide?
   - What does the program add to students' educational experiences?
   - How will the program provide such services?
7. Compile the ideas and draft a statement, no longer than five or six sentences in length.
8. Review the statement to ensure a group consensus. Make any necessary adjustments.
9. Finalize the technology program mission statement.

Establish Long-Term Goals. Consider the vision of *STL* and *AETL*—that all students can and should become technologically literate. Then consider the technology program goals. Do goals exist? If so, do they align with the program's mission and are they consistent with *STL* and *AETL*? If not, the Technology Program Committee should revise the program goals. If the program does not have any goals, they will need to be written. The Technology Program Committee is strongly encouraged to designate a time frame for completing the goals. Some goals may be continuous or ongoing.

Goals define the Technology Program Committee's expectations for change. While the mission statement identifies the aim of the technology program, the goals provide direction for achieving that aim. The Technology Program Committee should write goals that are specific, measurable, achievable, relevant, and timely (Reeves, 2002). The Technology Program Committee must clearly define program goals that articulate the priorities of all stakeholders, both inside and outside the educational system. This creates opportunities for educators and the community to work together in developing student technological literacy.

Additionally, the goals should support and be supported by existing school structures. One way the Technology Program Committee can accomplish this is by aligning the technology program goals with state/provincial/regional accreditation systems (AETL *Program Standard 5, Guideline H)*.

Some sample technology program goals follow (please note that these examples are not intended to be all inclusive):

1. Develop and maintain technology courses that facilitate student technological literacy in the areas of medical technologies, agricultural and related biotechnologies, energy and power technologies, information and communication technologies, transportation technologies, manufacturing technologies, and construction technologies. Complete within two years.
2. Prepare students for success in a technological world by meeting technological literacy standards established at the local, state, and/or national levels. Complete within three years.
3. Maintain a technologically competent instructional staff that possesses and will sustain the knowledge, abilities, and expertise needed to implement the program. This is an ongoing goal.

Establishing Technology Program Goals

1. Utilize technological literacy standards (e.g., *STL* and *AETL*) as well as school district, state/provincial/regional, and national/federal standards in other academic areas *(*AETL *Program Standard 1, Guidelines A & B)*.
2. Develop goals that define program expectations for realizing the mission of the technology program.
3. Write goals that are specific, measurable, achievable, relevant, and timely (Reeves, 2002).
4. Ensure that the goals promote the study of technology across grade levels and disciplines for Grades K–12 *(*AETL *Program Standard 1, Guidelines C & D)*.
5. **Record the technology program goals in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**

On-The-Side: Program Goals

- Do the technology program goals align with technological literacy standards (e.g., *STL* and *AETL*) as well as school district, state/provincial/regional, and national/federal standards in other academic areas?
- Do the technology program goals align with the general purpose and mission of the school and school district?
- Do the technology program goals address community and business or industry concerns?

Establish Strategies for Goals. To progress toward or accomplish the technology program goals, the Technology Program Committee will want to consider intermediate strategies that it can take to achieve the goals and further the mission of the program. The term *strategies* was chosen as a more descriptive term than *objectives.* Strategies identify actions for accomplishing the program goals. They define the specific activity or activities to be accomplished. Technology program strategies not only advance students toward technological literacy, but encompass how technological literacy can be advanced within existing school or school district opportunities, missions, and goals. The Technology Program Committee will want to designate a time frame for completing the strategies. While it is recommended that the strategies be accomplished within a one-year time period, the Technology Program Committee is encouraged not to define strategies that will require longer to complete than the time frame established for the goals with which they are associated.

Some sample technology program strategies follow. These strategies define actions for accomplishing the first goal listed on page 43. Please note that these examples are not intended to be all inclusive:

> **Goal:** Develop and maintain technology courses that facilitate student technological literacy in the areas of medical technologies, agricultural and related biotechnologies, energy and power technologies, information and communication technologies, transportation technologies, manufacturing technologies, and construction technologies. Complete within two years.
>
> 1. Revise and/or develop curricula that ensure the articulated study of technology across Grades 6–8 in the areas of

medical technologies, agricultural and related biotechnologies, energy and power technologies, information and communication technologies, transportation technologies, manufacturing technologies, and construction technologies. Complete within 6 months.

2. Design and manage safe and up-to-date laboratory-classrooms that promote technological literacy. Complete within 8 months.
3. Design and implement student assessment that aligns with technological literacy standards and ensures and facilitates the development of student technological literacy. Complete within 8 months.
4. Plan and deliver technology instruction that enhances student learning and assessment. Complete within two years.

Establishing Strategies for Goals

1. Review one of the technology program's goals.
2. Identify the actions that need to be accomplished for reaching the goal. Consider all program elements: content, professional development, curricula, instruction, student assessment, and the learning environment.
3. **Record the strategies for accomplishing the program goal in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**
4. Complete Steps 1–3 for each program goal.

It is assumed that the Technology Program Committee will report back to others involved in the technology program and obtain input and feedback on actions proposed or being taken.

Establish Organizing Principles. Prior to establishing specific courses, the Technology Program Committee may want to consider how the standards and benchmarks may be "grouped" together to provide the basis for specific courses. Such *organizing principles* should be derived from the standards and benchmarks to be standards-based.

Organizing principles **can be derived from standards and benchmarks and provide a method of grouping standards and benchmarks together to form specific courses.**

Organizing principles are developed through a series of discussions and meetings with the Technology Program Committee. To this point, the Committee has thought very globally about the needs of the community in relation to the standards. Through its vision and mission, it has determined where the program should go and how it is expected to get there. Through the organizing principles, the Committee will begin to narrow the focus on the content of the program. The following example describes how the Committee Chairperson can help facilitate the development of these principles.

Establishing Organizing Principles: An Example

The Northtown County Technology Program Committee meets twice a month to consider the new technology program that will be instituted at its four high schools, nine middle schools, and twenty elementary schools. The chair of the Committee facilitated the development of a vision and mission that are based upon the content standards for technological literacy and the five dimensions of technology that are covered by those standards:

With the standards in mind:

1. What are the three most important technology concepts that students should know?
2. What are the most important ideas about technology that students should be able to transfer from one situation to another?
3. What should students be able to do that will prepare them for living in the Northtown community?
4. What must students know and be able to do to live productively in an ever-changing, technological, global society?

Chairman Lee sent these questions to the Committee one week before the meeting. The members of the Committee were charged with developing answers to these questions on their own and were asked to be ready to share these with other members. On the night of the meeting, the members were divided up into groups of three, and they were asked to share the answers to the questions. One person was nominated to present answers to the group. The task was to identify six to eight organizing principles for the program—using the questions provided by Chairman Lee to help formulate them. Chairman Lee further facilitated the group to consensus through a series of exercises that narrowed the organizing principles down to seven for the program. In order of importance, the committee identified the following organizing principles:

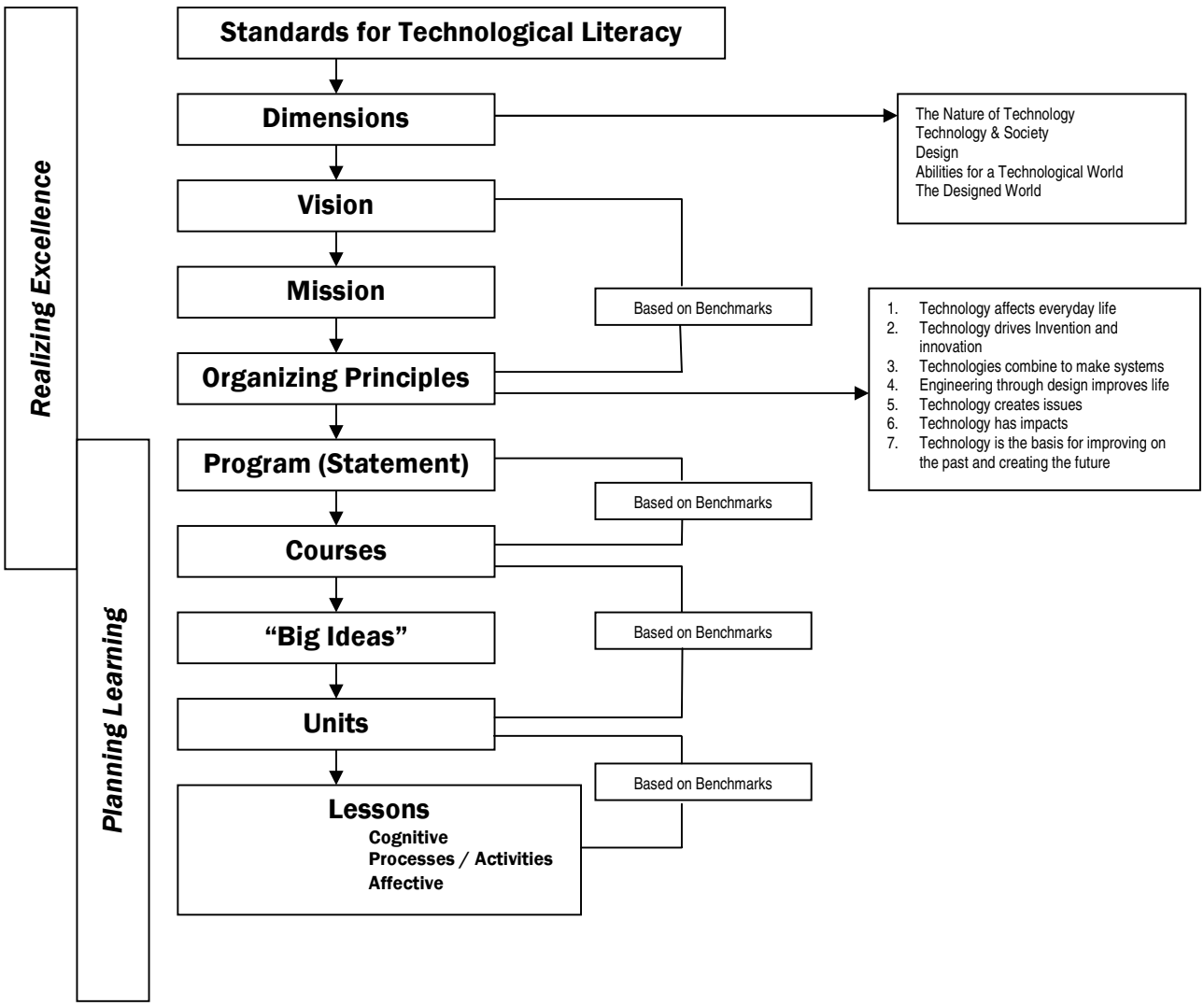
1. Technology has and continues to affect everyday life.
2. Invention and innovation are thinking and doing processes that improve our lives.
3. Technologies are combined to make technology systems.
4. Technology creates issues that change the way people live and interact.
5. Technology is the basis for improving on the past and creating the future.
6. Technology impacts society and must be evaluated to determine if it is good or bad.
7. Engineering improves life by design.

Notice that the seven principles in the example on page 46 are very large concepts that identify major content organizers for the program. It is at this point—after the development of the organizing principles—that the program begins to take a shape with which teachers and other curriculum developers are more familiar. The next step is to develop a *program statement* upon which courses are developed based on the identification of benchmarks for each organizing principle. (Note that the number of courses does not necessarily have to be the same as the number of organizing principles—for example, there may be more than one organizing principle for each course.)

Record the technology program organizing principles in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).

Note: Figure 3 is a flow chart that shows the basic elements of a standards-based technology program. Notice that *Realizing Excellence* leads users through identifying courses (explained on pp. 49–51). One resource to help teachers and other curriculum developers create units and lessons for technology courses is the addendum document, *Planning Learning* (ITEA, 2005b).

Figure 3. A Standards-Based Technology Program



Write a Program Statement. The next step is to develop a program name and a statement that clearly defines the overall purpose and function. It should be noted that this statement will be used in a variety of publications, so the intent is to tailor it to the audience that will be receiving it. In most cases, this statement is used by states or school systems to promote the program to parents and students.

Record the technology program statement in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).

Writing a Program Statement: An Example

The Northtown County Technology Program Committee, after identifying seven organizing principles for its new technology program, uses these principles to draft program statements. The Committee determined that for the secondary program (Grades 6–12), two versions of the statement were needed. One was for use by the district supervisor for approval and funding, and the second was more student-oriented for the course guides that are published each winter for student registration in middle and high schools. The Committee, after much discussion, decided that the program should be called "Engineering by Design" and wrote the following two program statements:

> **Engineering By Design: District/State Level Program Description (for Secondary Schools).** This program provides students with a foundation on the role of technology in everyday life along with a broad range of technology skills that make them aware of technology around them. Students completing the program will become technologically literate by learning the concepts and the roles that engineering, design, invention, and innovation have in creating technology systems that help make life easier and better. Students learn that technology must be evaluated to determine the positive and negative effects and how these have shaped today's global society. The key component of the program is that students become knowledgeable about technology and use hands-on lessons to apply and transfer this knowledge to common problems.
>
> **Engineering By Design: Student-Oriented Program Description (for Secondary Schools).** Students in this program use hands-on lessons to learn how the concepts and the roles that engineering, design, invention, and innovation have in creating technology systems that help make life easier and better. They learn to apply and transfer this knowledge to common, everyday problems. Students learn how to evaluate technology, studying the impacts of technology and the issues that result. Students learn to present the positive and negative consequences of technology and discuss how these have shaped today's global society. The program incorporates mathematics and science concepts and provides a strong background for students investigating careers in all career-focused academies.

Solicit Approval. Achieving standards-based reform of technology programs requires the cooperation of administration, including principals and supervisors. "Without administrative support, it is unlikely that your program will flourish" (VanZandt & Hayslip, 2001, p. 97). Once the technology program mission statement and goals are developed, the Technology Program Committee will find it beneficial to receive initial "approval" from administrative decision makers ***in writing***, whether at the school, school district, or state level. This initial approval ensures that resources will be accessible to the Technology Program Committee to support the needs of the technology program. Soliciting administrative approval assures that administration is open to technology program enhancement and will consider the propositions of the Technology Program Committee, including the need for funding and other resources.

Structure the Technology Program

Laying the groundwork gives the Technology Program Committee a platform for building the study of technology into every classroom, across grade levels and disciplines. The mission and goals agreed upon by program stakeholders and the resources that administration is willing to provide will guide technology program revision or development.

Becoming standards-based means basing the entire program on standards. **Alignment requires that technological literacy standards provide the foundation for program components.** Standards-***based*** programs start with standards. Standards-***reflected*** programs, on the other hand, start with program elements that already exist. Teachers then try to make connections to standards. Connecting existing program components to show links to standards **does not necessarily ensure that technological literacy is the intended outcome of the program**.

Identify and Document Courses. *STL* describes the content that should be studied across Grades K–12. The 20 standards identify what students should know, understand, and be able to do related to technology. Benchmarks add detail to the standards and are provided in grade "bands" (K–2, 3–5, 6–8, and 9–12). While it is not necessary to address all 20 standards in any given grade level, it is necessary that all of the *STL* standards and benchmarks be addressed within each grade band.

The Technology Program Committee must identify how *STL* standards and benchmarks will be articulated across the K–12 continuum.

The number of courses developed at each grade band will depend upon the number of students being served, the facilities and time available,

Ensuring that programs are standards-based does not necessarily require "starting from scratch." Comparing where you are now with where you want to go will help the Technology Program Committee determine what changes are needed to realize standards-based technology programs. In some instances, elements of a program will demand adjustment; in other instances, entire programs may need to be transformed.

The goal is to meet all of the standards through the benchmarks. ITEA does not recommend that users eliminate any of the benchmarks over the K–12 experience; however, teachers may find it desirable to add additional benchmarks.

and the allocated resources, among other things. In any case, students should learn basic technological ideas in elementary school that progress to more sophisticated concepts by high school.

Course titles should reflect the broader picture of the technological world and not focus on a specific aspect of that world. Again, the Technology Program Committee may want to consider how the standards and benchmarks may be "grouped" into organizing principles to provide the basis for specific courses. While organizing principles should be derived from the standards and benchmarks to be standards-based, they should *not* drive the selection of standards and benchmarks, as this would result in courses that are standards-reflected. A similar strategy was used by ITEA to structure its model technology education program course guides (see pp. iii-iv).

The Responsibility Matrix Form, Appendix G, can be used by the Technology Program Committee to identify the standards that will be taught at each grade level. The completed form will then provide the basis for establishing grade specific courses across Grades K–12. Additionally, the Technology Program Committee will need to consider state/regional/provincial, school district, and school technological literacy standards as well as standards in other content areas.

Some sample course titles follow:

The program consists of seven courses in Grades 6–12 that build on experiences provided in elementary school.

6th Grade	Exploring Technology	9 weeks
7th Grade	Invention and Innovation	9 weeks
8th Grade	Technology Systems	18 weeks
9th Grade	Foundations of Technology	1 credit 36 weeks
10–12th Grades	Technological Issues	1 credit 36 weeks
	Impacts of Technology	1 credit 36 weeks
	Engineering Design	1 credit 36 weeks

Identifying and Documenting Courses

1. Determine the standards that will be addressed at each grade level of the program. The Responsibility Matrix Form in Appendix G will be helpful in establishing grade level goals for each course.
2. Consider the number of students the program must serve, the facilities available, and the resources available.
3. Identify the courses that will be taught at each grade level, ensuring that they progress from basic concepts to more sophisticated ones.
4. Determine the purpose of each course.
5. Provide a brief overview of each course.
6. List the prerequisites for each course.
7. **Record all of the course information in the Structuring Standards-Based Technology Programs Workbook (see Appendix H).**

Establish An Action Plan. An action plan is often used to improve the current situation, consistent with a program's mission and goals. It typically contains **assignments, resource allocations, schedules, and evaluation criteria**, among other things. Once a decision is made regarding how content will be structured into specific courses, the Technology Program Committee should consider the actions it must take to develop the courses across grade levels and disciplines *(*AETL *Program Standard 5, Guidelines A & D)*. Committee members must propose what steps or activities must be taken to align the program with technological literacy standards. Do curricula demand revision? Does the learning environment need updating? Questions such as these will help the Technology Program Committee identify the **specific actions** that need to occur. In some instances, the strategies for accomplishing the program goals may define the actions that teachers will take to align programs with technological literacy standards. In other instances, the Technology Program Committee will want to identify more specific actions than those defined by the strategies. In any case, the Technology Program Committee will need to derive the actions from the strategies delineated for achieving program goals. For example, if the strategy indicates that curricula needs revision, the Technology Program Committee might identify the actions as: 1. Review research about available standards-based curriculum materials; 2. Identify standards-based curriculum materials available for purchase; and 3. Determine how available materials correlate with the mission and goals of the program, for example. These initial actions provide the

Nationally developed content standards in other academic areas include (but are not limited to):

- ***National Science Education Standards*** **(NRC, 1996)**
- ***Benchmarks for Science Literacy*** **(AAAS, 1993)**
- ***Principles and Standards for School Mathematics*** **(NCTM, 2000)**
- ***Geography for Life: National Geography Standards*** **(GESP, 1994)**
- ***National Standards for History*** **(NCHS, 1996)**
- ***Standards for the English Language Arts*** **(NCTE, 1996)**
- ***National Educational Technology Standards for Students: Connecting Curriculum and Technology*** **(ISTE, 2000)**

Technology Program Committee with an opportunity to identify what needs to be done before formal recommendations are given to administrative decision makers.

Note: Those users who are revising a technology program will want to consider the current state of their programs. The assignments specified will help the Technology Program Committee bring the program from its current state to its desired state, where we want to go.

On-The-Side: Action Planning

At the minimum, the elements that affect student learning must be standards-based. This requires:

- ***Content*** that is based on the standards in *STL* as well as state/regional/provincial, school district, and school standards *(*AETL *Program Standard 1, Guidelines A & G)*. The content studied should provide opportunities for cognitive, psychomotor, and affective learning *(*AETL *Program Standard 1, Guideline E). (Note: The identification of grade specific courses that are based on technological literacy standards is one way for the Technology Program Committee to align program content with standards.)*
- ***Professional development*** that is consistent with "Professional Development Standards" (chapter 4) of *AETL*. (See *Developing Professionals: Preparing Technology Teachers* [ITEA, 2005a].)
- ***Curricula*** that enable all students to attain technological literacy *(*AETL *Program Standard 2, Guideline C). (See Planning Learning: Developing Technology Curricula* [ITEA, 2005b].)
- ***Instruction*** that is designed to meet curricular goals and student needs and consistent with research on how students learn technology *(*AETL *Program Standard 2, Guidelines A, B, G, & H)*.
- ***Student assessment*** that is consistent with "Student Assessment Standards" (chapter 3) of *AETL. Note: Program evaluation requires the use of effective student assessment.* As student assessment practices are planned, teachers ensure to incorporate student commonality and diversity in a manner that enhances learning *(*AETL *Program Standard 3, Guideline E).* (See *Measuring Progress: A Guide to Assessing Students for Technological Literacy* [ITEA, 2004].)
- ***Learning environments*** that are up-to-date and adaptable and support student interactions and abilities to question, inquire, design, invent, and innovate *(*AETL *Program Standard 1, Guideline F; Standard 4, Guidelines A & B)*.

Much of the responsibility for aligning program components with technological literacy standards will be left to the technology teacher. The Technology Program Committee, however, can assist teachers in doing this by identifying what needs

to be done to make the program standards-based. For each action identified, the Technology Program Committee must **decide *who* will be responsible** for accomplishing it. As suggested by VanZandt and Hayslip (2001), "involving people in developing the program will make them even more committed to its implementation, and involving as many as possible will help to ensure a broad base of support" (p. 85). This requires that teachers, administrators, and the community approach program revision or development together. Technology Program Committee members should identify the roles technology teachers, other content area teachers, students, parents, administrators, and community members will take in program revision or development.

Once individuals are given specific assignments, they should **determine the resources** they will need to successfully accomplish those activities. The successful operation of the technology program will require that teachers and students have access to equipment, tools, and materials. The equipment, tools, and materials needed by the technology program will not only include a variety of technological equipment and tools, but curricular and instructional materials as well. Please note that teachers and administrators may already have access to some of the needed resources, while additional means may need to be sourced and obtained. Those responsible for completing the assignments should consider the identification of resources as an opportunity to create a "wish list." They will also want to **estimate the implementation costs** for the revised program as well as the annual operating costs.

Finally, those responsible for completing the assignments will need to **determine a realistic completion date**. When will they be able to report the information back to the Technology Program Committee and offer their recommendations? Responsible parties may find it favorable to identify interim completion dates. This is especially helpful with large assignments or those that involve the assistance of multiple people.

As the action plan is drafted, the Technology Program Advisory Committee should advise the process, ensuring accuracy and that the suggestions are realistic. Changes should be made as necessary.

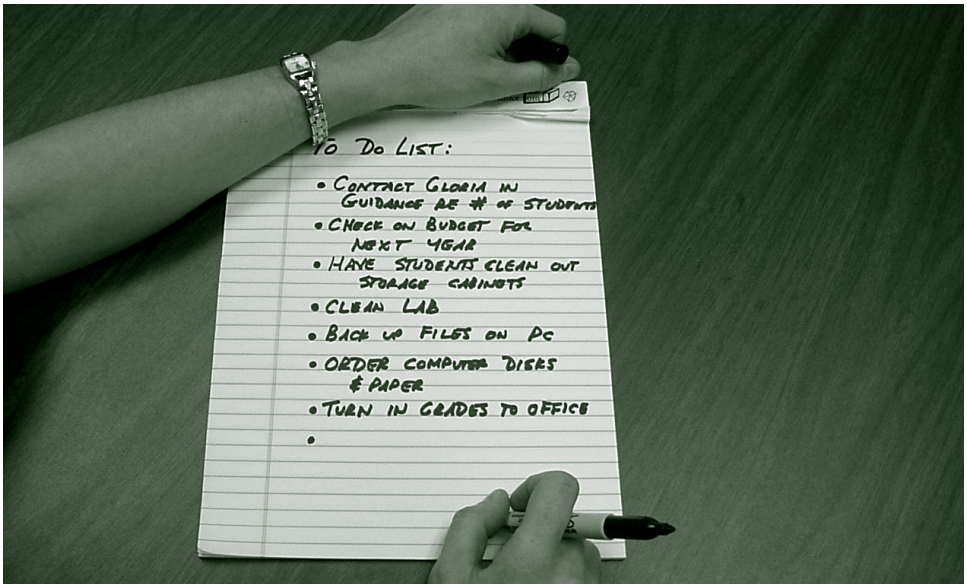
Once the initial actions are completed, those responsible for completing the assignments should review the information that they have collected. Based on the available information, they will need to **make a recommendation** to the Technology Program Committee about how to proceed. This recommendation will enable the Technology Program Committee to establish a budget and approach administrative decision makers for approval.

Establishing An Action Plan

1. **Fill in the action planning portion of the Structuring Standards-Based Technology Programs Workbook (see Appendix H) while addressing the items that follow.**
2. Identify what needs to be done. What tasks must be completed to revise or develop technology courses? At a minimum, the Technology Program Committee will need to consider content, professional development, curricula, instruction, student assessment, and the learning environment.
3. Decide *who* will be completing the identified tasks to generate assignments.
4. Each person or persons responsible for completing an assignment should *determine what is needed* to accomplish it. Consideration should be given to the resources available as well as those that need to be sourced and obtained. Resources might include monies, textbooks, equipment, and supplies, among other things. The *cost* of purchasing needed materials *should be estimated*.
5. Having considered what resources are available and what resources are still needed, those individuals with assignments should *develop a realistic timeline* for accomplishing the activities.
6. Once the initial actions are taken, those responsible for completing the assignments should *offer their recommendations* to the Technology Program Committee.
7. The Technology Program Committee should develop a budget based on the recommendations.

On-The-Side: Action Plans

One important aspect of action planning is the need to define staff requirements. As was previously mentioned, the teacher is the most important component affecting the quality of technology programs. If the technology program is to be implemented as designed by the Technology Program Committee, consideration should be given to the necessary personnel to facilitate technological study. The Technology Program Committee will want to specify staff requirements. Will current teachers demand staff development? Are additional technology teachers needed? How many additional teachers are needed to effectively guide student learning in the technology program? What qualities should the technology teacher possess? At a minimum, the Technology Program Committee will want to recommend that licensed, technologically competent teachers be hired to deliver technology content (AETL *Program Standard 2, Guidelines E, I, and J*).



Develop a Budget. The Technology Program Committee must establish its budget to reflect the resource needs of the program. The recommendations provided in the action plan will offer some direction to the Technology Program Committee as the budget is developed. Committee members may find it helpful to organize their budget to correspond with the components of the program: content, professional development, curricula, instruction, student assessment, and the learning environment. In developing the budget, the Technology Program Committee should consider the ideal state but prioritize the needs that are the minimum to successful implementation.

Note: This is the last action that corresponds with the workbook in Appendix H.

Developing a Budget

1. Consult the recommendations in the action plan.
2. Identify categories for organizing the resource needs.
3. List the estimated costs.
4. Calculate the total cost.
5. Re-check resource needs and figures.
6. **Attach a copy of the completed budget to the Structuring Standards-Based Technology Programs Workbook (see Appendix H) in preparation for submission to administrative decision makers.**

Secure Resources

As VanZandt and Hayslip (2001) suggest, "you can have the best plan in the world, and it will sit on the shelf—unused and unappreciated—if you do not have the support of all the human and material resources needed to get the job done" (p. 96). The Technology Program Committee must secure the resources that will be needed to move the technology program from its current state to its desired future state of being standards-based. This will be a matter of ensuring that the appropriate resources are available to accomplish missions, goals, and curricular objectives *(*AETL *Program Standard 5, Guidelines G & L)*.

***Obtain Funding*.** The successful operation of the technology program requires that monies be available to support teachers and students in teaching and learning. The Technology Program Committee secures funding from administration. **Committee members submit the appropriate pages of the Structuring Standards-Based Technology Programs Workbook (see Appendix H) to administrative decision makers, with any necessary attachments (e.g., a budget)**, and secure monies based on the recommendations in the action plan. The Technology Program Committee may need to revisit the Structuring Standards-Based Technology Programs Workbook to prioritize assignments based on the funds and other resources made available to them. If additional funding is necessary or desired, the Technology Program Committee investigates external funding sources that are approved by administration. This might include various granting sources such as local, state, and national businesses, industries, agencies, organizations, or foundations.

Obtaining Funding

1. Estimate the amount of financial support needed based on mission, goals, and action plan recommendations.
2. Present the budget to administration. Determine the amount of monetary support that administration is willing to contribute.
3. Decide whether or not the amount to be contributed by administration is sufficient to accomplish the assignments established in the action plan.
4. If additional funding is desired, identify appropriate external funding sources.
5. Solicit monies from the external funding source following the procedure established by the funding source (generally a proposal).
6. Review the budget to determine how monies will be allocated to those individuals with assignments per the action plan.

On-The-Side: Grant Writing

One of the primary aspects of successful grant writing is matching a need to a funding source. In some cases, a grant writer is specifically hired to help coordinate the process, but many times this task is left to those who plan to enact the idea or project. In any case, **good grant proposals start with good ideas and achievable deliverables.** Once the need is articulated and a realistic process for carrying out the plan and sustaining the results is conceived, funding sources can be explored. Many times funding can be obtained with local support from business and industry in a relatively short amount of time. In cases where a large project is conceived requiring larger funds, the grant writers may need to look to state, regional, or national business and industry or government agencies, which typically require a more elaborate, formalized submission process and a longer wait prior to dispensing of funds. Of course, any combination of funding sources may serve to achieve the project goals, including a small start-up grant to get the project rolling. Teachers should consult with their administrators about possible sources for grants. Once the project is funded, administrative coordination, monitoring, and reporting is essential to set the stage for future funding opportunities.

Access Laboratory-Classrooms. The Technology Program Committee must secure laboratory-classrooms where students can learn and teachers can teach. In elementary school, the study of technology occurs in the regular classroom. Elementary school classrooms should provide teachers with adequate physical space for teaching technology *(*AETL *Program Standard 4, Guideline I).* In middle and high school, the study of technology occurs in dedicated technology laboratory-classrooms. Technology laboratory-classrooms should contain a minimum allotment of 100 square feet per pupil, inclusive of safe ancillary space *(*AETL *Program Standard 4, Guideline J).*

On-The-Side: Learning Environments

Technology learning environments should be:

- Designed to facilitate delivery of *STL* and satisfy "Program Standards" *(*AETL *Program Standard 4, Guideline F).*
- Safe, up-to-date, and adaptable *(*AETL *Program Standard 4, Guideline G).*

On-The-Side: Technology Safety Program

The technology teacher will need to implement a written, comprehensive safety program (AETL *Program Standard 4, Guideline C*). The safety plan should promote student development of knowledge and abilities for the safe application of appropriate technological tools, machines, materials, and processes (AETL *Program Standard 4, Guideline D*). Some other recommendations to consider in establishing a safety program include:

- The facilities and equipment should be designed, constructed, and maintained to ensure a safe learning environment. This includes, but is not limited to, the utilization of proper lighting, proper exhaust system equipment, and non-skid surfaces, among others.
- The existence of a safety program is recorded and kept on file. This includes, but is not limited to, lesson plans documenting instruction for safety, and emergency procedures for responding to accidents.

Implement, Monitor, and Adjust

Structuring the technology program provides the Technology Program Committee with a detailed "blueprint" for framing student learning. As the program develops and students are engaged in technological study, the Technology Program Committee should monitor the effectiveness of the program. This requires a mechanism to be in place for teachers and administrators to monitor technological study to ensure that all students attain technological literacy across Grades K–12.

The *Management system* ensures that the vision of the technology program is being achieved through the courses that deliver content to students. Further, the system ensures that the courses in the program remain rooted in *STL* (and other content standards, as appropriate) for content and *AETL* for delivery of content.

Establish and Utilize a Management System. By now, the Technology Program Committee should be regarding the study of technology as a system. Ensuring that all students study technology across grade levels and disciplines requires consistent monitoring *(*AETL *Program Standard 1, Guidelines J & K)*. In the preceding actions, the Technology Program Committee has considered the "broad view" of the total undertaking. It is not enough, however, for the Committee to simply complete this series of actions and "call it quits." Successful programs require that monitoring and adjustment occur through the establishment and utilization of a management system *(*AETL *Program Standard 5, Guideline J)*.

While the management system will be unique to each program, it is likely to be a responsibility of the teacher. In situations where multiple technology teachers are responsible for a technology department, a department chairperson will likely perform many of the managerial tasks.

Provide In-Service and Hire Teachers. The Technology Program Committee specified staff requirements earlier in the planning process. Once funding is obtained and the "go ahead" is secured by administration, staffing is an issue that will need to be addressed. The Technology Program Committee will want to ensure that administration is aware of its staffing needs. The hiring of technology teachers will be the decision of administration. The Technology Program Committee might assist in this process by providing its recommendations to administrators.

Professional development for staff will need to be planned to satisfy the needs of the technology teachers—ultimately reflecting the needs of K–12 students. Professional development is a continuous process of lifelong learning and growth that begins early in life, continues through the undergraduate, pre-service experience, and extends through the in-service years.

The Technology Program Committee takes the necessary steps to inform educators about professional development offerings. Additionally, Committee members:

- Support sustained professional growth and development of all educators *(*AETL *Program Standard 2, Guideline F).*
- Support professional technology organization engagement by teachers and management personnel *(*AETL *Program Standard 5, Guideline K).*

Note: Specific requirements for the professional development of technology teachers are detailed by "Professional Development Standards" (chapter 4) of *AETL*.

Allocate Funds and Other Resources. To carry out the action plan, it is likely that those assigned to specific actions will need to access resources that are not currently available. The Technology Program Committee will need to allocate funding to the responsible parties to enable them to complete their assignments. The Technology Program Committee will need to review the action plan and the budget to determine what monies are available for use in accomplishing the various assignments. In some instances, this will require prioritizing assignments based on the needs of the program as funding may not be available to "do it all."

Schedule Courses and Recruit Students. The Technology Program Committee positions the study of technology so that administration mandates instruction in the study of technology as part of the core educational experience for all students *(*AETL *Program Standard 1, Guideline H)*. Technology teachers, guidance counselors, and administrators work together to schedule students into courses so that the number of students in a dedicated technology laboratory-classroom does not exceed its capacity *(*AETL *Program Standard 4, Guidelines E & H)*. Once the program is up and running, the technology teacher works with the guidance department to ensure that course enrollment is sustained. Technology teachers serve as advisors of student organizations (e.g., the Technology Student Association [TSA] or Junior Engineering Technical Society [JETS]) to develop student leadership opportunities *(*AETL *Program Standard 2, Guidelines D & J)*. Students become advocates for technology courses and the program.

Market and Promote the Study of Technology. Sustaining the technology program will require that the Technology Program Committee develop strategies to market and promote technological study to teachers, students, parents, administrators, guidance counselors, and the community *(*AETL *Program Standard 5, Guidelines C & F)*. Creating a successful marketing campaign will take time and consideration by the Technology Program Committee. Successful campaigns should be planned, continuous, and pro-active. Public awareness and support for the study of technology is a significant aspect of every technology program, and teachers may require training on how to organize effective marketing campaigns (see Meade, 2004 and Fitzgerald, 2004).

As the Technology Program Committee begins to identify marketing strategies, it will first want to consider the message it wants to send and the audience to which the message will be sent. Is the purpose of the message only to engage and inform, or should the message also elicit action? Whatever methods Committee members use to promote the study of technology should be aligned with community priorities as well as the mission and goals of the program. Some points to remember as you "get the message out" include:

- Present the message in the receiver's self-interest.
- Be concise, to-the-point, and stimulating.
- Select spokespersons carefully.
- Repeat message several times in a variety of formats.

It is also helpful to remember that students can be wonderfully effective as "salesmen" and "saleswomen," and their opinions are trusted and valued. Likewise, guidance counselors are an important audience in attracting students to educational programs.

Potential methods that the Technology Program Committee might consider to use in getting the message out include:

- Handouts
- Presentations at parent/teacher organization meetings
- Listservs
- Websites
- Student organizations (e.g., TSA, JETS, etc.)
- Business support
- Positive newspaper articles
- Press releases
- Other media (e.g., television and radio)

Note: Appendix J contains some sample marketing items.

Evaluate and Revise

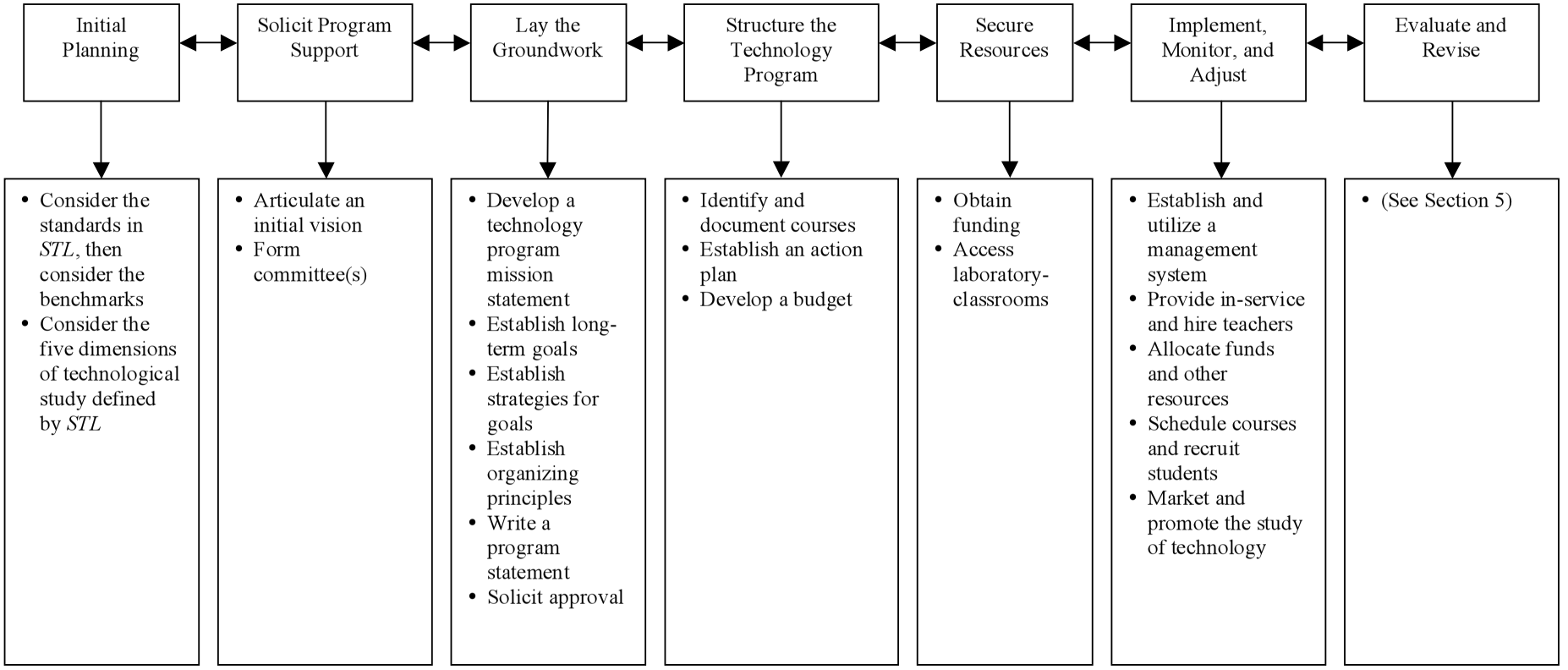
Program evaluation and revision certifies that technology programs facilitate and ensure technological literacy. Technology program evaluation should be consistent with "Program Standards" of *AETL* and enable data collection for accountability *(*AETL *Program Standard 5, Guidelines B & E)*. The Technology Program Committee should implement continuous evaluation that promotes adaptability to enhance the study of technology *(*AETL *Program Standard 1, Guideline L)*. Section 5 of *Realizing Excellence* provides suggestions for the

Technology Program Committee to consider as technological study is evaluated within their school or school district. Additionally, the Technology Program Committee may find it helpful to develop a rubric that specifically addresses the elements of the program being revised or developed. This will aid the Committee in making judgments about the degree to which the program is accomplishing its mission, goals, and strategies.

Support for Technological Study

Making technological literacy a reality requires a strong system of support. Engaging in program design and development as presented in this section will provide a support mechanism for schools and school districts (see Figure 4). The mechanism will be composed of teachers, students, parents, administrators, and community members who support each other. Together, we must be committed to helping all students attain technological literacy. We must work to build technology programs that meet the needs of our students and the priorities of our communities. Technology programs should create inviting atmospheres that welcome input and assistance from everyone committed to developing a technologically literate populace.

Figure 4. Structuring Standards-Based Technology Programs Revisited



SECTION 5

Evaluating Technology Programs

This section provides suggestions for the Technology Program Committee to use as it evaluates technological study, including reporting the results of evaluation and planning for program revision based upon those results.

In the case of program evaluation, the Technology Program Committee is concerned with the whole picture of the program and not simply its component parts.

Evaluation should encompass all components of the program, including content, professional development, curricula, instruction, student assessment, and the learning environment.

Program evaluation is a systematic, continuous process that enables the Technology Program Committee to examine the technology program as a whole, identifying successes and deficiencies, reporting findings to all those concerned, and making plans for revision. In establishing a system for program evaluation, appropriate procedures need to be used. The field of technology has a dynamic nature. As such, technological study should routinely be adjusted to keep up with the changes that are occurring in technology and education.

Please note that a "one size fits all" approach to evaluation does not exist. Therefore, it is important that individual teachers, administrators, and other stakeholders consider how these suggestions apply to their own localities.

The Scope of Evaluation

Many times the term *evaluation* is misunderstood and feared by educators. Evaluation is the process of determining the significance or worth of an educational program or a component of the program (e.g., a curriculum). As the Technology Program Committee engages in program evaluation, they will once again be thinking from a "big picture" perspective. **Program evaluation must encompass the evaluation of all components of the program, including content, professional development, curricula, instruction, student assessment, and the learning environment**, across grade levels. In other words, **we want to assure that the coordination of all program components ensures and facilitates technological literacy for all students** *(*AETL *Program Standard 3, Guidelines A–J)*. The suggestions presented in this section are not specific to the evaluation of a specific program component. Rather, this section focuses on how the evaluation data from individual program components can be collectively viewed.

Program Evaluation: A Collection of Evidence

Program evaluation provides the Technology Program Committee with an overall picture of the "condition" of the program. Committee members must gather and analyze a variety of data from multiple sources to be able to make a judgment about the program. The Technology Program Committee will try to assemble the results from the evaluation of individual program components in a manner that sheds light on overall program concerns, such as: *Is the program's mission being satisfied and are its goals and strategies being achieved?* The suggestions that follow are intended to assist the Technology Program Committee as they systematically and continuously evaluate the technology program *(*AETL *Program Standard 3, Guideline B)*.

The Technology Program Committee must evaluate programs consistent with the standards and guidelines of "Program Standards" in *AETL* (*AETL* Program Standard 3, Guidelines A & G). Additionally, they will want to ensure that *STL* provides the basis upon which the program was built.

Evaluation Versus Assessment

For the purpose of clarification in the addenda series, the writers have taken the position that programs are evaluated and students are assessed. Both evaluation and student assessment play significant roles in the evaluation of technology programs. Program evaluation is the process by which data are collected about each program component to determine how well the overall program design is achieving its mission and goals. Teachers, administrators, and other stakeholders use the evidence collected by evaluation to make revisions and plan future learning. Student assessment, on the other hand, refers to the systematic, multi-step process of collecting evidence of learning, understanding, and abilities and using that information to inform instruction and provide feedback to the learner. Student assessment is one element of the program that affects student learning and effective student assessment is utilized in program evaluation *(*AETL *Program Standard 3, Guideline F)*. Both student assessment and the larger scope of program evaluation need to accommodate for student commonality and diversity, ensuring that students are able to succeed on equal terms regardless of interests, cultures, abilities, socio-economic backgrounds, or special needs *(*AETL *Program Standard 3, Guideline E).*

***Evaluation* refers to the collection and processing of information and data to determine how well a design meets the requirements and to provide direction for improvements.**

***Student assessment* is a systematic, multi-step process of collecting evidence on learning, understanding, and abilities and using that information to inform instruction and provide feedback to the learner, thereby enhancing learning.**

An Approach to Program Evaluation

Effective program evaluation is planned, carried out, and used to make necessary revisions to program components. The process that follows is general enough to apply to any program. Adjustments should be made to consider individual needs.

- Plan for Program Evaluation
- Collect an Analyze Evidence
- Gather and Analyze Additional Data
- Report Findings
- Revise

Plan for Program Evaluation. The Technology Program Committee may want to consider the following as they plan for evaluation.

- What is the purpose of evaluation?
- Who are the audiences for the results of evaluation?
- What questions will guide evidence gathering?
- What data is available to answer evaluation questions?
- How will findings be reported?
- What are the plans for revising program components?

Program evaluation is concerned with the degree to which the technology program mission, goals, and curricular objectives are being achieved. In other words, the Technology Program Committee wants to answer the question: *Does the technology program facilitate and ensure technological literacy for all students?*

To answer this question, the Technology Program Committee will need to ask and answer a series of intermediate questions related to individual program components, including:

- Is the ***program*** aligned with "Program Standards" (chapter 5) of *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003) and with state/provincial/regional accreditation systems *(*AETL *Program Standard 5, Guideline H)*?
- Is ***content*** based on the standards in *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002) as well as state/regional/provincial, school district, and school technological literacy standards?
- Is ***professional development*** consistent with "Professional Development Standards" (chapter 4) of *AETL*?
- Do ***curricula*** enable all students to attain technological literacy *(*AETL *Program Standard 2, Guideline C)*?
- Is ***instruction*** designed to meet curricular goals and student needs? Is instruction consistent with research on how students learn technology *(*AETL *Program Standard 2, Guidelines A & B)*? Is the evaluation of instruction conducted on a prescribed schedule *(*AETL *Program Standard 3, Guideline C)*?
- Is ***student assessment*** consistent with "Student Assessment Standards" (chapter 3) of *AETL*?
- Are ***learning environments (laboratory-classrooms)*** up-to-date and adaptable? Do learning environments support student interactions and abilities to question, inquire, design, invent, and innovate *(*AETL *Program Standard 4, Guidelines A & B)*?

Collect and Analyze Evidence. A great deal of data will be available to the Technology Program Committee. Not only will the results from the evaluation of the program's component parts be available, teachers and

administrators will have access to the data used to arrive at such evaluations. It is up to the Technology Program Committee to decide what information provides reasonable evidence for use in answering the program evaluation questions. The management system should assist Committee members in maintaining data collection for accountability and be aligned with "Program Standards" (chapter 5) of *AETL*. One method by which this can be accomplished is by creating a rubric based upon the actions the Technology Program Committee planned to take based upon the funding they received and the other available resources. Such a rubric might, for example, weight the actions in terms of importance. [3]

Developing a technologically literate citizenry will require support from educators, parents, and communities.

Table 4. Sample Evaluation Data Sources

Professional Development	• Teacher Surveys • Teacher Interviews • Teacher Observations • Self Assessment / Peer Assessment
Curricula	• Field Test Results • Pilot Test Results • Student Surveys • Student Interviews • Student Assessment Results (Formative and Summative)
Instruction	• Teacher Self Assessment • Principal Observations • Student Assessment Results (Formative and Summative)
Student Assessment	• Concept Mapping • Debates • Demonstrations / Presentations • Discussions / Interviews • Journals / Logs • Modeling / Prototyping • Multiple-Choice Tests • Observations • Open-Ended Questioning • Portfolios • Projects • Self Assessment / Peer Assessment • True-False Tests
Learning Environment	• Accreditation Reviews • Safety Records

[3] Information on developing rubrics is provided in the student assessment addenda in this publication series, *Measuring Progress* (ITEA, 2004). While the information is geared toward student assessment rather than programs as a whole, it exemplifies how a rubric works that may be applied to rubrics in general.

Throughout the course of program planning and implementation, teachers and administrators will have collected data about professional development, curriculum, instruction, student assessment, and the learning environment. The Technology Program Committee will need to review this data and determine which evidence it will use to determine the impact of the overall program on student learning. Table 4 identifies some sources from which evaluation data may be drawn.

Gather and Analyze Additional Evaluation Data. The Technology Program Committee will need to determine if any information is "missing." In other words, from the available data is the Technology Program Committee able to answer all of their questions about the various aspects of the program? If additional information is needed to fully answer a question, the Technology Program Committee will be responsible for selecting procedures for data collection from various constituencies. This can be done through interviews, observations, testimonials, and opinion surveys. Additional means of attaining pertinent data could include checklists and rating scales. Interviews could be conducted by members of the Technology Program Committee, along with observations of what is actually happening in the laboratory-classroom.

After the Technology Program Committee has gathered and organized the evaluation data, the data must be analyzed. Data should be reviewed in light of the mission, goals, and curricular objectives. A decision about the effectiveness of the program will need to be made based on all available data.

Report Findings. The results of program evaluation are used to communicate the status of and progress toward technological literacy in our schools. The results of the program evaluation must be reported to program stakeholders to inform them about this status as well as to solicit action. What is reported should be closely linked to the key decision makers who will take action and create results. The report of the findings should be provided in a written format so that the key decision makers can have a hard copy of what was evaluated. A presentation of the results should be made to the key decision makers within the school, school district, and the community. The report should be succinct and to the point. A major purpose of this report is to stimulate discussion among those who can and will make use of the results. **Appendix K is a form that can be filled out by those persons responsible for completing assignments and returned to those members of the Technology Program Committee who will compile the report.** Please note that this form is an example; it is only one method of many that could be devised by Technology Program Committees to manage data compilation.

Listed below are some recommendations for reporting the program evaluation findings:

1. An evaluation report containing data, notations of discrepancies, and recommendations is made annually.
2. Findings from the program evaluation data collection and analysis efforts are disseminated to the appropriate decision makers for the program.
3. Discrepancies between program status and standards (*STL* and *AETL*) are reported to the appropriate decision makers.
4. Recommendations for correcting deficiencies are reported to appropriate decision makers.

Typical reports could include the following elements:

- Title
- Purpose of the program evaluation
- Background information
- Who conducted the program evaluation
- Timetable for program evaluation
- Specific topics covered in the program evaluation
- Populations who provided information on the evaluation
- Analysis of results
- Summary of results

Revise (AETL *Program Standard 3, Guidelines D & J*). After the results of the program evaluation have been shared through the final report to the key decision makers, the next process is to begin revising the program based on the evaluation results. Prior to engaging in program revision, the Technology Program Committee may find it helpful to refer back to Appendix F, The Current State of the Program: Where Are We Now. Committee members should be able to complete the last column of the form, which will indicate the changes that have been made to the program. The Technology Program Committee will want to refer to Section 4 of *Realizing Excellence* to review the suggestions for aligning the technology program with technological literacy standards. Areas of deficiency should be addressed first. The Technology Program Committee is encouraged to monitor the program revision over the period of time that this revision occurs. It is important that the individuals and groups assigned to revise the program continually report back to the Technology Program Committee of their progress or lack of it.

A System for Improvement

Evaluation should not be viewed as an event, but as an ongoing process for program improvement.

It is important that ongoing efforts be developed and maintained to assure that the quality of the technology program is monitored. Evaluation should not be viewed as an event, but as an ongoing process for program improvement. A formal system of program evaluation should be established so that data can be collected on a regular basis in each school or school district. Through continuous evaluation, programs will be systematically improved, and we can continue to ensure that all students attain technological literacy in the future.

SECTION 6
The Need for Change

This section encourages users of *Realizing Excellence* to begin focusing on the changes they can make to realize standards-based technological study in all schools across the Nation.

Achieving the vision expressed by *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002) and *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standard* (*AETL*) (ITEA, 2003), that all students can and deserve to attain technological literacy, will require teachers, administrators, parents, and communities to work together to provide leadership for technological study within our schools and school districts. As Linda Lambert (1998) recommends "School leadership needs to be a broad concept that is separated from person, role, and a discrete set of individual behaviors. It needs to be embedded in the school community as a whole. Such a broadening of the concept of leadership suggests shared responsibility for a shared purpose …" (p. 5). Student attainment of technological literacy must become a purpose to which teachers, students, parents, administrators, and the community are committed. Together, the school and community can advance students toward technological literacy.

Technological Study: What, How, Who, Why, When, and Where

Attaining a technologically literate citizenry is possible through K–12 education. Not only are standards available that identify the "what" (*STL*) and "how" (*AETL*) of technological literacy, the "who" exists within the some 36,000 technology teachers delivering technology content in the United States (Meade & Dugger, 2004.)

Why should we be concerned with developing student technological literacy? Success in a technological world requires a level of technological literacy that enables students to become informed consumers, marketable employees, and ultimately independent citizens. Making technological literacy a reality requires a strong system of support. We must work together to build technology programs in our schools that are supported by educators, parents, and the community. We should continually seek opportunities to enhance our programs to ensure that they reflect the changing technological world. We must revise programs to ensure that the needs of our students and communities are continually being met. Our technology programs should create inviting atmospheres that welcome input and assistance from everyone committed to developing a technologically literate populace.

The question that remains, however, is "when" and "where" will local, state, and/or national policies recognize the importance of preparing students with the technological knowledge, abilities, and understandings necessary for competent interaction with the technological world? When will schools and school districts establish technology programs across grade levels—Kindergarten through Grade 12? When will all students be provided access to technology education courses that deliver basic technological concepts in elementary school and more comprehensive ideas in high school? When will teachers of other content areas recognize that technological study complements coursework in many disciplines? The reality is that technology education professionals do not know the answers to many of these questions. But unless educators continue to strive for standards-based change in their own programs, these important revisions may never come to fruition. The when needs to be NOW, and it is time for leadership to make change in technological study in all schools across the Nation.

Getting the Job Done

Reeves (2002) indicates, "…most educational leaders spend a disproportionate amount of time not on their champions or in discovering strengths but in an endless battle with weakness and belligerence" (p. 73). If we, as educators and concerned individuals, want to see our students progress toward technological literacy, we must not be one of those educational leaders that battles with weakness and belligerence. We must allow our successes to continue to motivate us to make change and accept the notion that the "when" is now and always. "…it is faster and easier to build upon strength than to compensate for weakness" (Reeves, 2002, p. 72).

Motivation for Change

As Shelly Montgomery expressed in her "teacher story" (see page 18):

> It is not important where I am in regards to retirement, or how much time I have left. What is important is what I am doing for my students today for their futures. We need to consider whether we are just teaching a skill or whether we are teaching students how to think, solve problems, and make mathematics and science come alive. For our profession, I fear our programs will continue to shut down one by one unless we build something that can last for the next generation.

Technological literacy can last for the next generation. After all, intelligent and thoughtful interaction with technology requires an ability to use, manage, evaluate, and understand it. If we, as a profession, can look beyond our own careers to our students' careers, we likely can see future teachers, farmers, engineers, nurses, factory workers, and household workers, among many other professions. If we look to the future, we will also likely see a world that will rely more and more upon technology. At this crucial phase, it is certain that every technology educator active in the profession today will impact the future of the discipline, either by stagnating the vision of technological literacy or advancing it. It is time for technology education leadership to stand up and be counted by participating actively in standards-based reform.

APPENDICES

APPENDIX A

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Teacher Story Credits

pages 17–18	Building a Technology Education Program In Engineering Design for the High School. Written by Shelly Montgomery, Memorial High School.
pages 19–21	Children's Designing and Engineering Lab for Elementary School. Written by Janis Detamore, McGaheysville Elementary School.
pages 23–26	Designing Technology Courses That Are Standards-Based. Written by William E. Dugger, Jr., Shelli D. Meade, Lisa Delany, and Crystal Nichols, Technology for All Americans Project.
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APPENDIX B

Listing of *STL* Content Standards

From International Technology Education Association. (2000/2002). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

Note: These standards are provided for reference only. All standards should be met through the benchmarks that follow each standard in* Standards for Technological Literacy*, which is available online at www.iteawww.org.

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 the abilities to apply the design process.
Standard 12. Students will develop the abilities to use and maintain technological products and systems.
Standard 13. Students will develop the 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
Listing of *AETL* Student Assessment Standards

From International Technology Education Association. (2003). *Advancing excellence in technological literacy: Student assessment, professional development, and program standards.* Reston, VA: Author.

Note: These standards are provided for reference only. All standards should be met through the guidelines that follow each standard in* Advancing Excellence in Technological Literacy*, which is available online at www.iteawww.org.

Standard A-1: Assessment of student learning will be consistent with *Standards for Technological Literacy: Content for the Study of Technology (STL).*

Standard A-2: Assessment of student learning will be explicitly matched to the intended purpose.

Standard A-3: Assessment of student learning will be systematic and derived from research-based assessment principles.

Standard A-4: Assessment of student learning will reflect practical contexts consistent with the nature of technology.

Standard A-5: Assessment of student learning will incorporate data collection for accountability, professional development, and program enhancement.

APPENDIX D

Listing of *AETL* Professional Development Standards

Taken from International Technology Education Association. (2003). *Advancing excellence in technological literacy: Student assessment, professional development, and program standards*. Reston, VA: Author.

Note: These standards are provided for reference only. All standards should be met through the guidelines that follow each standard in* Advancing Excellence in Technological Literacy*, which is available online at www.iteawww.org.

Standard PD-1: Professional development will provide teachers with knowledge, abilities, and understanding consistent with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*).

Standard PD-2: Professional development will provide teachers with educational perspectives on students as learners of technology.

Standard PD-3: Professional development will prepare teachers to design and evaluate technology curricula and programs.

Standard PD-4: Professional development will prepare teachers to use instructional strategies that enhance technology teaching, student learning, and student assessment.

Standard PD-5: Professional development will prepare teachers to design and manage learning environments that promote technological literacy.

Standard PD-6: Professional development will prepare teachers to be responsible for their own continued professional growth.

Standard PD-7: Professional development providers will plan, implement, and evaluate the pre-service and in-service education of teachers.

APPENDIX E

Listing of *AETL* Program Standards with Guidelines

Taken from International Technology Education Association. (2003). *Advancing excellence in technological literacy: Student assessment, professional development, and program standards.* Reston, VA: Author.

Standard P-1: Technology program development will be consistent with *Standards for Technological Literacy: Content for the Study of Technology (STL)*.

Guidelines for meeting Standard P-1 require that the teacher(s) responsible for the technology program consistently

A. Align program content with *STL*.
B. Align program content with school district, state/provincial/regional, and national/federal standards in other academic areas.
C. Plan and develop the program across disciplines.
D. Plan and develop the program across grade levels.
E. Assure that the program incorporates suitable cognitive, psychomotor, and affective learning elements.
F. Promote adaptability for program enhancement.

Guidelines for meeting Standard P-1 require that administrators responsible for establishing the cross-curricular technology program consistently

G. Stipulate that content be aligned with *STL*.
H. Mandate instruction in the study of technology as part of the core educational experience for all students.
I. Advocate content that complements school district, state/provincial/regional, and national/federal standards in other academic areas.
J. Assure that the study of technology occurs across disciplines.
K. Assure that the study of technology occurs across grade levels.
L. Promote adaptability to enhance the study of technology.

Standard P-2: Technology program implementation will facilitate technological literacy for all students.

Guidelines for meeting Standard P-2 require that the teacher(s) responsible for the technology program consistently

A. Provide instruction that is consistent with research on how students learn technology.
B. Provide instruction that is designed to meet curricular goals and student needs.
C. Design and implement curricula that enable all students to attain technological literacy.
D. Develop student leadership opportunities.

Guidelines for meeting Standard P-2 require that administrators responsible for establishing the cross-curricular technology program consistently

E. Employ licensed teachers to deliver technology content.
F. Support sustained professional growth and development of all educators.
G. Encourage instruction that is consistent with research on how students learn technology.
H. Advocate instruction that is designed to meet curricular goals and student needs.
I. Commit to the recruitment of technologically competent teachers.
J. Encourage all teachers to develop student leadership opportunities.

Standard P-3: Technology program evaluation will ensure and facilitate technological literacy for all students.

Guidelines for meeting Standard P-3 require that the teacher(s) responsible for the technology program consistently

A. Develop and utilize evaluation consistent with standards and guidelines in "Program Standards."
B. Implement and use systematic, continuous evaluation.
C. Evaluate instruction on a regular basis.
D. Plan for program revision.

E. Accommodate for student commonality and diversity.
F. Utilize effective student assessment.

Guidelines for meeting Standard P-3 require that administrators responsible for establishing the cross-curricular technology program consistently

G. Assure that evaluation is consistent with standards and guidelines in "Program Standards."
H. Employ systematic, continuous evaluation.
I. Encourage evaluation of instruction on a regular basis.
J. Plan for program revision.

Standard P-4: Technology program learning environments will facilitate technological literacy for all students.

Guidelines for meeting Standard P-4 require that the teacher(s) responsible for the technology program consistently

A. Create and manage learning environments that are supportive of student interactions and student abilities to question, inquire, design, invent, and innovate.
B. Create and manage learning environments that are up-to-date and adaptable.
C. Implement a written, comprehensive safety program.
D. Promote student development of knowledge and abilities for the safe application of appropriate technological tools, machines, materials, and processes.
E. Verify that the number of students in the technology laboratory-classroom does not exceed its capacity.

Guidelines for meeting Standard P-4 require that administrators responsible for establishing the cross-curricular technology program consistently

F. Provide learning environments that are designed to facilitate delivery of *STL* and satisfy "Program Standards."
G. Provide learning environments that are safe, up-to-date, and adaptable.
H. Ensure that the number of students in a dedicated technology laboratory-classroom does not exceed its capacity.
I. Provide elementary school classrooms with adequate physical space for teaching technology.
J. Provide dedicated technology laboratory-classrooms in middle and high schools with a minimum allotment of 100 square feet per pupil, inclusive of safe ancillary space.

Standard P-5: Technology program management will be provided by designated personnel at the school, school district, and state/provincial/regional levels.

Guidelines for meeting Standard P-5 require that the teacher(s) responsible for the management of the technology program consistently

A. Develop and use action plans based on *STL*.
B. Maintain data collection for accountability.
C. Market and promote the study of technology.

Guidelines for meeting Standard P-5 require that administrators responsible for the management of the cross-curricular technology program consistently

D. Develop and use action plans based on *STL*.
E. Maintain data collection for accountability.
F. Market and promote the study of technology.
G. Provide funding, support, and resources to accomplish missions, goals, and curricular objectives.
H. Align technology programs with state/provincial/regional accreditation systems.
I. Establish articulated and integrated technology programs district wide.
J. Establish and utilize a management system.
K. Support professional technology organization engagement by teachers and management personnel.
L. Provide resources and opportunities to support technology teachers and other content area teachers in the teaching and learning process.

APPENDIX F

The Current State of the Program: *Where Are We Now?*

Directions: Following each item in the list to the left, enter the appropriate number in the appropriate column based upon your evaluation of each item. Adding the numbers in the first two scoring columns will give you a general "score," which is only useful when comparing it against the total number achieved when filling out future generations of the form. In other words, this score is not intended to provide comparisons from one locality or district to another.

Note: In the first scoring column, 1 means "Not at All," while in the second and third scoring columns, 1 means "To a Great Extent."

Note: Users of this form will benefit from being familiar with the technological literacy standards in* Standards for Technological Literacy *(ITEA, 2000/2002) and* Advancing Excellence in Technological Literacy *(ITEA 2003).

		To what extent does the technology program address this standards-based aspect?				To what extent does this standards-based aspect need revision or development?				To what extent has this standards-based element been addressed in program revision or development?				
Considerations for Standards-Based Technology Program Planning		Not at All	Somewhat	Mostly	To a Great Extent	To a Great Extent	Mostly	Somewhat	Not at All	To a Great Extent	Mostly	Somewhat	Not at All	
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**Comments**
Program Content Advances Student Technological Literacy	• Program content aligns with *STL*.													
	• Program content aligns with school district, state/provincial/regional, and national/federal standards in other academic areas.													
	• Students develop an understanding of the nature of technology.													
	• Students develop an understanding of technology and society.													
	• Students develop an understanding of design.													
	• Students develop abilities for a technological world.													
	• Students develop an understanding of and are able to select and use technologies of the designed world.													

Considerations for Standards-Based Technology Program Planning		To what extent does the technology program address this standards-based aspect?				To what extent does this standards-based aspect need revision or development?				To what extent has this standards-based element been addressed in program revision or development?				
		Not at All	Somewhat	Mostly	To a Great Extent	To a Great Extent	Mostly	Somewhat	Not at All	To a Great Extent	Mostly	Somewhat	Not at All	
		1	2	3	4	1	2	3	4	1	2	3	4	Comments
Program Curricula Advance Student Technological Literacy	• Students develop an understanding of the nature of technology.													
	• Students develop an understanding of technology and society.													
	• Students develop an understanding of design.													
	• Students develop abilities for a technological world.													
	• Students develop an understanding of and are able to select and use technologies of the designed world.													
Program Instruction Advances Student Technological Literacy	• Students develop an understanding of the nature of technology.													
	• Students develop an understanding of technology and society.													
	• Students develop an understanding of design.													
	• Students develop abilities for a technological world.													
	• Students develop an understanding of and are able to select and use technologies of the designed world.													

	Considerations for Standards-Based Technology Program Planning	To what extent does the technology program address this standards-based aspect?				To what extent does this standards-based aspect need revision or development?				To what extent has this standards-based element been addressed in program revision or development?				
		Not at All	Somewhat	Mostly	To a Great Extent	To a Great Extent	Mostly	Somewhat	Not at All	To a Great Extent	Mostly	Somewhat	Not at All	
		1	2	3	4	1	2	3	4	1	2	3	4	Comments
Student Assessment Advances Student Technological Literacy	• Students develop an understanding of the nature of technology.													
	• Students develop an understanding of technology and society.													
	• Students develop an understanding of design.													
	• Students develop abilities for a technological world.													
	• Students develop an understanding of and are able to select and use technologies of the designed world.													
Learning Environments Advance Student Technological Literacy	• Students develop an understanding of the nature of technology.													
	• Students develop an understanding of technology and society.													
	• Students develop an understanding of design.													
	• Students develop abilities for a technological world.													
	• Students develop an understanding of and are able to select and use technologies of the designed world.													

	Considerations for Standards-Based Technology Program Planning	To what extent does the technology program address this standards-based aspect?				To what extent does this standards-based aspect need revision or development?				To what extent has this standards-based element been addressed in program revision or development?				
		Not at All	Somewhat	Mostly	To a Great Extent	To a Great Extent	Mostly	Somewhat	Not at All	To a Great Extent	Mostly	Somewhat	Not at All	
		1	2	3	4	1	2	3	4	1	2	3	4	**Comments**
Assessment Tools/Methods are Appropriate for Gathering Evidence of Student Technological Literacy Learning	• Evidence is gathered to indicate that students understand the content in *STL*.													
	• The evidence gathered attempts to measure student understanding of the big ideas that are extracted from the content standards.													
	• Evidence of cognitive, psychomotor, and affective learning is gathered.													
	• Assessment incorporates technological problem solving.													
	• Assessment facilitates critical thinking and decision making.													
	• A variety of assessment tools and methods are used.													
Student Assessment Data are Used	• Data are used to improve teaching and learning.													
	• Data are used to monitor ongoing student progress.													
	• Data are used to identify levels of student technological literacy.													
	• Data are used to determine instructional effectiveness.													
	• Data are communicated to the students and other stakeholders.													
	• Data are used to guide teacher professional development.													
	• Data are used to guide program enhancement.													

Considerations for Standards-Based Technology Program Planning	To what extent does the technology program address this standards-based aspect?				To what extent does this standards-based aspect need revision or development?				To what extent has this standards-based element been addressed in program revision or development?				
	Not at All	Somewhat	Mostly	To a Great Extent	To a Great Extent	Mostly	Somewhat	Not at All	To a Great Extent	Mostly	Somewhat	Not at All	
	1	2	3	4	1	2	3	4	1	2	3	4	Comments
Student assessment is evaluated for quality.													
The technology program is based on standards.													
The technology program engages students in authentic learning opportunities.													
The technology program provides students with equal educational opportunities that are challenging.													
The technology program is appealing to all students.													
The technology program is administered across grade levels.													
The technology program is administered across disciplines.													
The technology program supports professional learning communities.													
The technology program involves business and the community in its operation.													
Technology program practices are based on current research.													
Technology program components are not rigid and their design enables change as needed.													
Technology program effectiveness is monitored. Program successes and failures are reported to stakeholders.													
The technology program is promoted through a planned marketing campaign.													

APPENDIX G

Responsibility Matrix Form

Directions: Page 1 of this form should be used to indicate which standards in *Standards for Technological Literacy* (*STL*) will be addressed at each grade level of the technology program. Fill in this form using "X" to indicate maximum coverage, "√" to indicate moderate coverage, and "O" to indicate minimal coverage.

Responsibility Matrix Form Page 1

***STL* Standards**	***STL* Coverage in the Technology Program**												
	Elementary Classrooms						Technology Laboratory-Classrooms						
	K	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
***STL* 1.** Students will develop an understanding of the characteristics and scope of technology.													
***STL* 2.** Students will develop an understanding of the core concepts of technology.													
***STL* 3.** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.													
***STL* 4.** Students will develop an understanding of the cultural, social, economic, and political effects of technology.													
***STL* 5.** Students will develop an understanding of the effects of technology on the environment.													
***STL* 6.** Students will develop an understanding of the role of society in the development and use of technology.													
***STL* 7.** Students will develop an understanding of the influence of technology on history.													
***STL* 8.** Students will develop an understanding of the attributes of design.													
***STL* 9.** Students will develop an understanding of engineering design.													
***STL* 10.** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.													
***STL* 11.** Students will develop the abilities to apply the design process.													
***STL* 12.** Students will develop the abilities to use and maintain technological products and systems.													
***STL* 13.** Students will develop the abilities to assess the impact of products and systems.													
***STL* 14.** Students will develop an understanding of and be able to select and use medical technologies.													
***STL* 15.** Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.													
***STL* 16.** Students will develop an understanding of and be able to select and use energy and power technologies.													
***STL* 17.** Students will develop an understanding of and be able to select and use information and communication technologies.													
***STL* 18.** Students will develop an understanding of and be able to select and use transportation technologies.													
***STL* 19.** Students will develop an understanding of and be able to select and use manufacturing technologies.													
***STL* 20.** Students will develop an understanding of and be able to select and use construction technologies.													

Directions: Page 2 of this form should be used to indicate which standards from other content areas will be addressed at each grade level of the technology program. Multiple copies of this form may be needed. Fill in this form using "X" to indicate maximum coverage, "√" to indicate moderate coverage, and "O" to indicate minimal coverage.

Responsibility Matrix Form Page 2

Other Content Area Standards	Standards Coverage in the Technology Program												
	Elementary Classrooms						Technology Laboratory-Classrooms						
	K	1	2	3	4	5	6	7	8	9	10	11	12

APPENDIX G

Directions: Page 3 of this form should be used to indicate which standards in *Standards for Technological Literacy* (*STL*) will be addressed at each grade level in other content area classrooms. Multiple copies of this form may be needed. Fill in this form using "X" to indicate maximum coverage, "√" to indicate moderate coverage, and "O" to indicate minimal coverage.

Responsibility Matrix Form Page 3

***STL* Standards**	***STL* Coverage in Other Content Areas**													
	6	**7**	**8**	**9**	**10**	**11**	**12**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
***STL* 1.** Students will develop an understanding of the characteristics and scope of technology.														
***STL* 2.** Students will develop an understanding of the core concepts of technology.														
***STL* 3.** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.														
***STL* 4.** Students will develop an understanding of the cultural, social, economic, and political effects of technology.														
***STL* 5.** Students will develop an understanding of the effects of technology on the environment.														
***STL* 6.** Students will develop an understanding of the role of society in the development and use of technology.														
***STL* 7.** Students will develop an understanding of the influence of technology on history.														
***STL* 8.** Students will develop an understanding of the attributes of design.														
***STL* 9.** Students will develop an understanding of engineering design.														
***STL* 10.** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.														
***STL* 11.** Students will develop the abilities to apply the design process.														
***STL* 12.** Students will develop the abilities to use and maintain technological products and systems.														
***STL* 13.** Students will develop the abilities to assess the impact of products and systems.														
***STL* 14.** Students will develop an understanding of and be able to select and use medical technologies.														
***STL* 15.** Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.														
***STL* 16.** Students will develop an understanding of and be able to select and use energy and power technologies.														
***STL* 17.** Students will develop an understanding of and be able to select and use information and communication technologies.														
***STL* 18.** Students will develop an understanding of and be able to select and use transportation technologies.														
***STL* 19.** Students will develop an understanding of and be able to select and use manufacturing technologies.														
***STL* 20.** Students will develop an understanding of and be able to select and use construction technologies.														

Date: _____

Initial Vision

Directions: Define an initial vision for the technology program. It should incorporate why technological literacy is important to the community the program serves and society in general.

Initial Vision: _____

_____

_____

_____

_____

Technology Program Committee

Directions: Record the names and contact information of the individuals serving on the Technology Program Committee in the spaces provided below. Participation by technology teachers, other content area teachers, administrators, and guidance counselors is recommended.

1. Name: _____
   Title: _____
   School Name: _____
   Address: _____
   _____
   Phone Number: _____
   E-mail Address: _____

2. Name: _____
   Title: _____
   School Name: _____
   Address: _____
   _____
   Phone Number: _____
   E-mail Address: _____

3. Name: _____
   Title: _____
   School Name: _____
   Address: _____
   _____
   Phone Number: _____
   E-mail Address: _____

4. Name: _____
Title: _____
School Name: _____
Address: _____
_____
Phone Number: _____
E-mail Address: _____

5. Name: _____
Title: _____
School Name: _____
Address: _____
_____
Phone Number: _____
E-mail Address: _____

Technology Program Advisory Committee

Directions: Record the names and contact information of the individuals serving on the Technology Program Advisory Committee in the spaces provided below. Ensure representation by different community constituencies including parents, community members, business and industry personnel, technologists, engineers, college/university faculty, trade school representatives, former students, and retired professionals.

1. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

2. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

3. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

3. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

4. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

5. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

6. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

7. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

8. Name: _____
Title: _____
Address: _____
_____
Phone Number: _____ Fax Number: _____
E-mail Address: _____

Technology Program Mission Statement

Directions: Answer the questions that follow. Use your responses to these questions to draft a technology program mission statement. Review the statement to ensure a group consensus. Make any necessary adjustments to finalize the technology program mission statement.

1. What is the philosophical foundation of the school and/or school district?

   _____

   _____

2. What is the vision of national, state, and local standards for attaining technological literacy? _____

   _____

   _____

3. What are some of the unique features of the technology program that complement the school's philosophical foundation? _____

   _____

   _____

4. How does this program serve the overarching vision of the school and community?

   _____

   _____

5. Whom will the technology program serve? _____

   _____

   _____

6. What services will the technology program provide? _____

   _____

   _____

7. What does the program add to students' educational experiences? _____

   _____

   _____

8. How will the technology program provide such services? _____

   _____

   _____

Based on your responses to the preceding questions, compose a mission statement in no more than five or six sentences.

Review and revise the drafted mission statement, ensuring consensus of all stakeholders.

Long-Term Goals and Short-Term Strategies

Directions: Complete each section below.
Note: Make as many copies of this page as necessary.

List below a long-term technology program goal. The goal should be specific, measurable, achievable, relevant, and timely.

Now list the strategies that will be carried out for reaching the above goal.

Organizing Principles

Directions: Group the standards and benchmarks in *STL* to provide the basis for the courses that will be developed. Consider the five dimensions of technology in *STL*: The nature of Technology, Technology and Society, Design, Abilities for a Technological World, and the Designed World.

Program Statement

Directions: Start with a name for the program and proceed with a description of the overall purpose and function. Consider the audience who will use the statement.

STOP! Before planning for the technology program is continued, the Technology Program Committee should get preliminary approval in writing from administrative decision makers. Request administrative approval in writing.

APPENDIX I
Sample Letter to Advisory Committee Members

<Date>

<Name>
<Title>
<Address>
<Address>

Dear <Name>:

<School Name> is excited to announce that it will be developing and implementing a technology program to develop student knowledge and abilities to use, manage, evaluate, and understand technology. We will also be seeking ways to integrate the study of technology into the total school curriculum. We are excited to be building this program, and we would like to gain the support and advice of the community in this program building process.

This letter is an official invitation for you to serve on the Technology Program Advisory Committee for <School Name>. The advisory committee will provide advice to the Technology Program Committee on the best practice of planning the technology program in conjunction with the beliefs and interests of the community. We anticipate that the advisory committee will meet <how often> to provide specific advice on these aspects as well as how technology education can be integrated into other school subjects, especially science and mathematics. The advisory committee will most likely meet at <Where> for <How Long> meetings. The first meeting of the Technology Advisory Committee will be on <When> at <Where> <Give Address>. The time of the meeting will be from <Give Time Frame>.

If you agree to serve on the Technology Program Advisory Committee, please complete the enclosed form to confirm your commitment, and return it to me by <Give Date>, along with a biographical sketch that includes information on your background, past and present employment, and accomplishments. In addition, a recent black and white photo would be helpful for future public relation activities.

We appreciate your busy schedule, and so we thank you in advance for your consideration of this important task. We sincerely hope you will agree to be a part of the Technology Program Advisory Committee for <School Name>. If you have any questions, please feel free to give me a call.

Regards,

<Leader Name>
<Title>
<School Name>
<School Address>
<School Address>
<Phone Number>
<Fax Number>
<E-mail Address>

Enclosure

<School Name>
<School Address>
<School Address>
<Phone Number> <Fax Number>
<E-mail Address>

_____ Yes, I will serve on the Technology Advisory Committee for <School Name>.

_____ No, I cannot serve on the Technology Advisory Committee for <School Name>.

Comments: _____

_____

_____

Name (please print): _____

Title: _____

Business address: _____

_____

City: _____ State: _____ Zip Code: _____

Phone: (_____) _____ Fax: (_____) _____

Email: _____

Home address: _____

_____

City: _____ State: _____ Zip Code: _____

Phone: (_____) _____ Fax: (_____) _____

Email: _____

Preferred mailing address: _____ Business _____ Home

NEWS RELEASE

FOR IMMEDIATE RELEASE

Contact:
[Name]
[Title]
[Organization]
[Address Line]
[Address Line]
Phone
E-mail

Headline: The Headline Should Not Be in All Caps

[City], [State]—[Date]—[Your Company], [What Your Company Is or Does], today announced that _____ _____. State the main point of the press release in the first sentence. Mention who, what, why, where, when, and how in the first paragraph.

Continue with more detail, in order of importance, grouping ideas into paragraphs. Try to illustrate only one idea in each paragraph. You may want to insert significant quotes.

If you have space, you may want to use boilerplate information about your company or product, language that is used over and over to convey important ideas. This will provide further background information for readers who became interested by your first paragraph and the following development of the event.

You may choose to end on this boilerplate, or you may choose to write a conclusion. In any case, try to maintain a one page limit. The press release may be sent by e-mail, fax, or in some cases regular mail, although the preference is to create a sense of "breaking news." Another alternative is to write EMBARGOED on the top line of the press release and send the press release out prior to the time it is dated. This will indicate to those who receive the press release that they may not share the content of the document until that date (and time, if appropriate).

###
(This symbol marks the end of the press release)

This We Believe

Technology Education:

- Is an essential learning experience for all students at all grade levels, abilities, and backgrounds, so that they may confidently use, manage, assess, and understand technology.
- Provides the basic knowledge and technical skills needed to participate in society. It increases the economic capacity of nations and allows students to understand and apply advanced technologies so they will be prepared for either post-secondary education or entering the workforce.
- Enhances the opportunity for students to develop career awareness or career path preparation. It provides an exposure to a variety of technology related careers – from professional to industrial or service worker. The knowledge base learned through technology education is important to everyone as all members of society must continually learn in a changing society that is influenced by technology.
- Is a school subject that provides opportunities for practical experiences concerned with developing insights into technology, its evolution, utilization, and significance in our technological world. It fosters an awareness and appreciation of technology, its role in society, and in the formation of a culture.
- Helps people develop an understanding of technology in various cultural contexts. It fosters an awareness of how technology influences the global society.
- Engages learners in a wide range of activities. It fosters an inventive spirit, technological decision making, and a social conscience. It helps people to develop critical and creative problem-solving abilities related to the development of technology and its products, systems, and organizational structures. It encourages the assessment of technological developments and their related consequences to society, culture, and the natural environment.
- Forms a continuum with visual and applied arts, ranging from creative forms to the more exacting demands of machine tools and applied sciences.
- Provides for academic, technical, and social growth. It employs involvement with tools, machines, materials, and systems of technology. It enables all students to derive meaning from concrete experiences that result from the integration of mathematics, science, humanities, and engineering concepts. Through direct experience with a wide array of processes, knowledge, and contexts, it helps to develop technological literacy.
- Provides a wholesome change in learners by enhancing the understanding of how technology is changing the human-made world and the natural environment. It allows learners to experience the activities and habits of a designer, scientist, technologist, engineer, architect, producer, historian, and social critic as they engage in technological problems and issues of the present and future.
- Develops self-evaluation of attitudes toward constructive work and how this work can be used for health, recreation, or economic value. It helps to develop favorable attitudes toward creative thinking, and to character improvement – knowing and making the most of one's environment.
- Requires competence, compassion, a desire for excellence, and a vision from its educators. Teachers must possess creativity, ingenuity, enjoy working with people, and maintain a high degree of personal and professional integrity.

International Technology Education Association, 1914 Association Drive, Suite 201, Reston, VA 20191-1539
Phone: (703) 860-2100 Fax: (703) 860-0353 Email: itea@iris.org Web:http://www.iteawww.org

Programs or specific events can be promoted using postcards or fliers. This example shows a promotional card that was used by ITEA.

APPENDIX K
Program Evaluation & Revision Summary

Directions: Complete this form providing the requested information. Once recommendations for revision are made, action planning should occur to identify the parameters for the needed revision.

Evaluation Question(s)	Data Sources	Result(s) of Analysis	Recommendation for Revision(s)

Additional Comments: _____

_____

_____

APPENDIX L
References and Resources

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APPENDIX M

Glossary

The terms defined and described in this glossary apply specifically to *Realizing Excellence: Structuring Technology Programs.* These terms may have different meanings in different situations.

Some Acronyms Used in this Publication

AAAS American Association for the Advancement of Science.
AETL *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*.
CATTS Center to Advance the Teaching of Technology and Science.
GESP Geography Education Standards Project.
ISTE International Society for Technology in Education.
ITEA International Technology Education Association.
JETS Junior Engineering Technical Society.
NAE National Academy of Engineering.
NASA National Aeronautics and Space Administration.
NCHS National Council of History Standards.
NCTE National Council of Teachers of English.
NCTM National Council of Teachers of Mathematics.
NRC National Research Council.
NSF National Science Foundation.
STL *Standards for Technological Literacy: Content for the Study of Technology.*
TfAAP Technology for All Americans Project.
TSA Technology Student Association.

General Glossary Terms

Ability — The capacity to determine the application of knowledge and skills.

Accountability — The quality of being held answerable or responsible for, which may make one liable to being called to account.

Accreditation — A system designed to attest to the act of accrediting or the state of being accredited. An accreditation system would involve the approval of an institution of learning as meeting a prescribed standard or standards through a review board.

Across disciplines — Inclusive of all content area classrooms as appropriate to develop technological literacy.

Across grade levels — Inclusive of all grades specified in the identified levels of an institution of learning, such as across grades kindergarten through twelve for public education.

Action plan — A management strategy that includes program mission statements, goals, short- and long-range strategic planning, organization, evaluation, and responsibilities.

Action research — Inquiry-based research conducted by teachers that follows a process of examining existing practices, implementing new practices, and evaluating the results, leading to an improvement cycle that benefits both students and teachers.

Activity — A process, function, or task that occurs over a period of time and has recognizable results.

Administrator — Professional who manages any aspect of the educational system, including supervisors and teachers as appropriate.

Advisory committee — An organized body comprised of informed and qualified individuals with a specified responsibility to give advice in the development of an idea or process. Members may include parents, business and industry personnel, local engineers, technologists, and interested individuals.

Affective — Relating to, arising from, or influencing feelings or emotions.

Articulated/Articulation — A planned sequence of curricula and course offerings from Grades K–12. The planned sequence may involve looking at course offerings across grade levels (vertical articulation) or the curriculum at a single grade level (horizontal articulation).

Assessment — 1. See student assessment. 2. See evaluation. Note: *Realizing Excellence* differentiates between assessment and evaluation, taking the position that students are assessed and programs are evaluated.

Assessment principles — The basic truths, laws, or assumptions held in the use of assessment. The assessment principles that are in current use should enhance student learning, provide coherency of programs and courses, identify expectations.

Assessment tool — Any of the instruments completed by students that enable them to demonstrate their understanding (i.e., multiple-choice test, design brief, etc.).

Audience — Those for whom material is intended.

Authentic learning — Learning that attempts to replicate life outside the classroom.

Benchmark — In *Standards for Technological Literacy: Content for the Study of Technology* (ITEA, 2000/2002), it is a written statement that describes the specific developmental components by various grade bands (K–2, 3–5, 6–8, and 9–12) that students should know or be able to do in order to achieve a standard.

Big ideas — The large, important, profound, and lasting ideas that will endure over a long period of time.

Budget — A detailed plan of income and expenses expected over a certain period of time.

Checklist — An evaluative tool, which can take many forms, from a simple listing to a formal quarterly report of progress.

Cognitive — 1. Having a basis in or being reducible to empirical, factual knowledge. 2. A teaching method that recognizes the close relationship between what is known and what is to be learned. The teaching proceeds to build on the student's knowledge base by helping the student associate new material with something that is familiar.

Collaboration — A cooperative relationship that enables goals to be accomplished more effectively and comprehensively than by individual efforts.

Commonality — Similarity of interests, cultures, abilities, socio-economic backgrounds, and/or special needs.

Community — A body of people living in the same place under the same laws.

Concept mapping — An assessment approach involving the creation of a two-dimensional graphic representation that details the relationships among ideas.

Constituent/Constiuency — A person or entity that patronizes, supports, or offers representation.

Content — See content standards.

Content standards — 1. The standards in *Standards for Technological Literacy: Content for the Study of Technology* that provide written statements of the knowledge and abilities students should possess in order to be technologically literate. 2. The standards in other content areas that specify what students should know and be able to do, including those in *National Science Education Standards* or *Principles and Standards for School Mathematics*.

Context/Contextual — The circumstances in which an event occurs; a setting.

Continuous — Uninterrupted in time, sequence, substance, or extent.

Course — A series of units that lasts for a specified period of time (semester, year, etc.) and is designed around a specified school subject.

Criteria — Desired specifications (elements or features) of a product or system.

Critical thinking — The ability to acquire information, analyze and evaluate it, and reach a conclusion or answer by using logic and reasoning skills.

Cross-curricular technology program — Everything that affects student attainment of technological literacy, including content, professional development, curricula, instruction, student assessment, and the learning environment, implemented across grade levels and disciplines. The cross-curricular technology program manages the study of technology in technology laboratory-classrooms and other content area classrooms.

Curriculum/Curricula — Specification of the way content is delivered, including the structure, organization, balance, and presentation of content in the laboratory-classroom.

Data Collection — Prodeedure in which information from various sources are accumulated

Debate — An open discussion "for" or "against" an issue or question in which two teams of three or four students present an argument in front of a classroom audience.

Decision makers — Those responsible for examining several possible behaviors and selecting from them the one most likely to accomplish the individual's or group's intention. Cognitive processes such as reasoning, planning, and judgment are involved.

Demonstration — An assessment approach that involves student explanation and communication of their understanding of key ideas, concepts, and principles and their abilities of processes, techniques, and skills.

Design — An iterative decision-making process that produces plans by which resources are converted into products or systems that meet human needs and wants or solve problems.

Design process — A systematic problem-solving strategy, with criteria and constraints, used to develop many possible solutions to a problem or to satisfy human needs and wants and winnow (narrow) down the possible solutions to one final choice.

Disciplines — Specified realms of content.

Discussion — An assessment approach that involves idea-sharing of subject matter between student and teacher or among students. Teachers consider student ability to verbalize content and make "sense" of topics, issues, or information.

Educational standards — See standard.

Educational (instructional) technology — 1. The study of computers and other media. 2. The use of technological developments, such as computers, audiovisual equipment, and mass media, as tools to enhance and optimize the teaching and learning environment in all school subjects, including technology education.

Educators — Those professionals involved in the teaching and learning process, including teachers and administrators.

Effective — Produces the desired results with efficiency.

Embedded — To set or fix firmly into a statement or activity.

Enduring concepts — The large, important, profound, and lasting ideas that will remain valid over a long period of time.

Engineering — The profession of or work performed by an engineer. Engineering involves the knowledge of the mathematical and natural sciences (biological and physical) gained by study, experience, and practice that are applied with judgment and creativity to develop ways to utilize the materials and forces of nature for the benefit of mankind.

Engineering design — The systematic and creative application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems.

Equity — Fairness, impartiality, or justness.

Evaluate/Evaluation — Collection and processing of information and data to determine how well a design meets the requirements and to provide direction for improvements. Note: *Realizing Excellence* differentiates between assessment and evaluation, taking the position that students are assessed and programs are evaluated. See also program evaluation.

Evidence — The information that is intended to demonstrate or prove a level of understanding.

Expectations — Anticipated action that demonstrates understanding.

Experimentation — 1. The act of conducting a controlled test or investigation. 2. The act of trying out a new procedure, idea, or activity.

Feedback — Using all or a portion of the information from the output of a system to regulate or control the processes or inputs in order to modify the output.

Flexibility — The quality of being adaptable or variable.

Formative evaluation — Ongoing evaluation of the program and its components. It provides information to educators and other concerned individuals on revising the overall program.

Formative student assessment — Ongoing student assessment in the classroom. It provides information to students and teachers to improve teaching and learning.

Goal — The expected end result. In standards-based education, this can be specifically applied to learning, instruction, student assessment, professional development, and program enhancement.

Grade band — A grouping of different grades in school (e.g., K–2, 3–5, 6–8, and 9–12).

Grade level — 1. A stage in the development of a child's education (i.e., K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12). 2. From grade to grade and across grade bands (i.e., Grades 2-3 or Grades 3-5).

Guideline — 1. In *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (ITEA, 2003), it is a specific requirement or enabler that identifies what needs to be done in order to meet a standard. 2. A suggestion to consider.

Horizontal articulation — A planned sequence of curricula and course offerings at a single grade level.

Implement/Implementation — To proceed with practical application.

Innovation — An improvement of an existing technological product, system, or method of doing something using both natural resources and human resources.

In-service — 1. A practicing educator. 2. Workshops, lectures, and other educational opportunities designed to keep practicing professionals abreast of the latest developments in their fields.

Instruction — The actual teaching process that the teacher employs to deliver the content to all students.

Instructional strategies — All of the elements necessary in the teaching and learning process. This includes curriculum development, laboratory-classroom planning, and evaluation, in addition to the delivery system to be used in the teaching process.

Instructional (educational) technology — 1. The study of computers and other media. 2. The use of technological developments, such as computers, audiovisual equipment, and mass media, as tools to enhance and optimize the teaching and learning environment in all school subjects, including technology education.

Integrated/Integration — The process of bringing all parts together into a whole.

Interview — A form of discussion that includes a planned sequence of questions, similar to a job interview. Students are not given information, as the objective is to collect data on student knowledge and abilities at a certain point in time.

Invention — A new product, system, or process that has never existed before, created by study and experimentation.

Journal — A record of understandings, reflections, and/or opinions written as periodic entries (daily, weekly).

Knowledge — 1. The body of truth, information, and principles acquired by mankind. 2. Interpreted information that can be used.

Laboratory-classroom — The environment in which student learning related to the study of technology takes place. At the elementary school level, this environment will likely be a regular classroom. At the middle and high school levels, a separate laboratory-classroom with areas for hands-on activities as well as group instruction, could constitute the environment.

Learning activities — Experiences provided to students that enable them to gain understandings.

Learning environment — Formal or informal location where learning takes place that consists of space, equipment, resources (including supplies and materials), and safety and health requirements.

Lesson — Day-by-day plan for learning in the classroom.

Market/Marketing — The act of encouraging others to buy a product or accept an idea or concept.

Mathematics — The study of abstract patterns and relationships that results in an exact language used to communicate about them.

Mission statement — The articulation of organized goals and strategies for realizing goals.

Modeling — The act of creating a model, such as a visual, mathematical, or three-dimensional representation in detail of an object or design, that is used to test ideas, make changes to a design, and/or learn more about what would happen to a similar, real object.

Objective — A specific item or proceedure that meets a designated goal.

Observation — The act or practice of noting and recording facts and events.

Open-ended questioning — An assessment approach in which the teacher guides the direction, understanding, and application of the information being taught through the use of questions (and also attempts to identify student misconceptions) and uses that information to adjust instruction.

Organizing principles — Focused topics or statements that are derived from educational standards and provide a method of grouping standards together to form courses in an educational program.

Outcome — A term used to indicate the result of an educational plan or program. Outcomes can also be the consequences of decisions made.

Peer assessment — An assessment method that involves the use of feedback from one student to another student, both students being of similar standing (grade level).

Performance — A demonstration of student-applied knowledge and abilities, usually by presenting students with a task or project and then observing, interviewing, and evaluating their solutions and products in order to assess what they actually know and are able to do.

Plan/Planning — A set of steps, procedures, or programs worked out beforehand in order to accomplish an objective or goal.

Policymakers — 1. Those representatives inside the educational, public, and governmental system who are responsible for public education at school, school district, state/provincial/regional, and national/federal levels. 2. Those individuals, businesses, or groups outside the public educational system who influence educational policy. This may include parents, clubs, organizations, businesses/industries, political activists, and any number of other citizens or groups of citizens who, while not directly and legally responsible for creating educational policy, nevertheless influence educational policy.

Portfolio — An assessment approach that involves the formal or informal, systematic, and organized collection of student work that includes results of research, successful and less successful ideas, notes on procedures, and data collected. A portfolio may be in many forms, from photographs depicting student growth and understanding to a specialized electronic journal showing work completed over a period of time.

Practical contexts — Everyday environments in which an event is likely to take place.

Presentation — An assessment approach that involves the performance or delivery of information.

Pre-service — 1. A teacher candidate. 2. Undergraduate education for those who intend to teach.

Priorities — The imposed sequences desired with respect to the scheduling of activities within previously imposed constraints.

Problem solving — The process of understanding a problem, devising a plan, carrying out the plan, and evaluating the plan in order to solve a problem or meet a need or want.

Process — 1. Human activities used to create, invent, design, transform, produce, control, maintain, and use products or systems. 2. A systematic sequence of actions that combines resources to produce an output.

Product — A tangible artifact produced by means of either human or mechanical work, or by biological or chemical processes.

Professional development — A continuous process of lifelong learning and growth that begins early in life, continues through the undergraduate, pre-service experience, and extends through the in-service years.

Professional development providers — Those who organize and/or deliver pre-service and in-service education, including teacher educators, principals, supervisors, and teachers as appropriate.

Professional learning community — Educators working collaboratively on issues dealing with learning, students, and teaching.

Program — Everything that affects student learning, including content, professional development, curricula, instruction, student assessment, and the learning environment, implemented across grade levels.

Program evaluation — Collection and processing of information and data to determine how well all components of the program—including content, professional development, curricula, instruction, student assessment and the learning environment—meets the requirements and to provide direction for improvements.

Program leadership — Those individuals who are dedicated to achieving standards-based programs.

Project — A teaching or assessment method used to enable students to apply their knowledge and abilities. These may take many forms and are limited by time, resources, and imagination.

Prototyping — The act of creating a prototype, such as an original type, form, or instance, that serves as a full-scale working model on which later stages are based or judged.

Psychomotor — 1. Physical behavior that has a basis in mental processes. 2. A teaching method that involves both mental processes and physical movement.

Reliable/Reliability — Capable of being relied upon; dependable; may be repeated with consistent results.

Research — Systematic, scientific, documented study.

Research and development (R&D) **—** The practical application of scientific and engineering knowledge for discovering new knowledge about products, processes, and services and then applying that knowledge to create new and improved products, processes, and services that fill market needs.

Resource — The things needed to get a job done. In a technological system, the basic technological resources are: energy, capital, information, machines and tools, materials, people, and time.

Rubric — An assessment or evaluative device based on the identified criteria taken from the content standards. Points or words are assigned to each phrase or level of accomplishment. This method gives feedback to the students about their work in key categories, and it can be used to communicate student performance to parents and administrators.

Safety — The opposite of risk. The probability that harm will not occur under specified conditions.

Science — Understanding the natural world.

Society — A community, nation, or broad grouping of people having common traditions, institutions, and collective activities and interests.

Stakeholders — Individuals or entities who have an interest in the success of a specific venture or program. Stakeholders in technology education may include teachers, administrators, school leaders, professional development providers, business and industry leaders, engineers, scientists, technologists, and others.

Standard — A written statement or statements about what is valued that can be used for making a judgment of quality.

Standards-based — Educational standards provide the content basis on which student learning is built. Everything that affects student learning is planned to support students as they attain standards.

Standards-based reform — An educational movement that supports maintaining high academic expectations, or standards, for all students that holds schools, teachers, and students accountable for student learning and achievement.

Standards-reflected — A connection is made to educational standards, but standards do not necessarily provide the basis for student learning. Teaching and assessment of standards is "hit or miss."

Strategy/Strategies — An elaborate and systematic plan of action.

Student assessment — A 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 learning.

Student learning — The act or process of aquiring knowledge, abilities, or understandings.

Study of technology — Also referred to as technological study. Any formal or informal education about human innovation, change, or modification of the natural environment. See also technology education.

Summative evaluation — Cumulative evaluation of the program and its components. It provides information to educators and other concerned individuals on revising the overall program.

Summative student assessment — Cumulative student assessment that usually occurs at the end of a unit, topic, project, or problem. It identifies what students have learned and also judges student performance against previously identified standards. Summative student assessment is most often thought of as "final exams," but it may also be a portfolio of student work.

System — A group of interacting, interrelated, or independent elements or parts that function together as a whole to accomplish a goal.

Systematic — Occurring on a regular basis; having a plan or order.

Teaching — The conscious effort to bring about learning in a manner that is clearly understood by the learner and likely to be successful. .

Technological literacy — The ability to use, manage, understand, and evaluate technology.

Technological literacy standards — The standards in *Standards for Technological Literacy: Content for the Study of Technology* and *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* that identify the content and provide criteria for the implementation of that content for developing technological literacy.

Technological study — See technology education.

Technological world — The products, methods, and processes involved in the innovation, change, or modification of the natural environment (world) to satisfy perceived human wants and needs.

Technology — The innovation, change, or modification of the natural environment to satisfy perceived human needs and wants.

Technology education — A school subject specifically designed to help students develop technological literacy.

Technology program — Everything that affects student attainment of technological literacy, including content, professional development, curricula, instruction, student assessment, and the learning environment, implemented across grade levels as a core subject of inherent value.

Technology program advisory committee — An ongoing and continuous committee that oversees the technology program and assists the Technology Program Committee as it makes important decisions, ensuring that school and community concerns are addressed.

Technology program committee — A working group that establishes the focus and direction of the technology program.

Test — 1. A method for collecting data. 2. A procedure for critical evaluation.

Troubleshooting — Locating and finding the cause of problems related to technological products or systems.

Understanding — A synthesis of knowledge and abilities that involves sophisticated insights and is reflected through performance in various contexts.

Unit — An organized series of learning activities, lectures, projects, and other teaching strategies that focuses on a specific topic related to the curriculum as a whole.

Valid/Validity — Having or containing premises from which the conclusion may logically be derived, correctly inferred, or deduced.

Vertical articulation — A planned sequence of curricula and course offerings across grade levels.

Visibility — Degree of exposure to public notice.

Vision — A contemplative image of future promise and possibility articulated with the intention to inspire others.

Workshop — A meeting or series of meetings devoted to discussion and demonstration of practical applications in a specialized field or subject.

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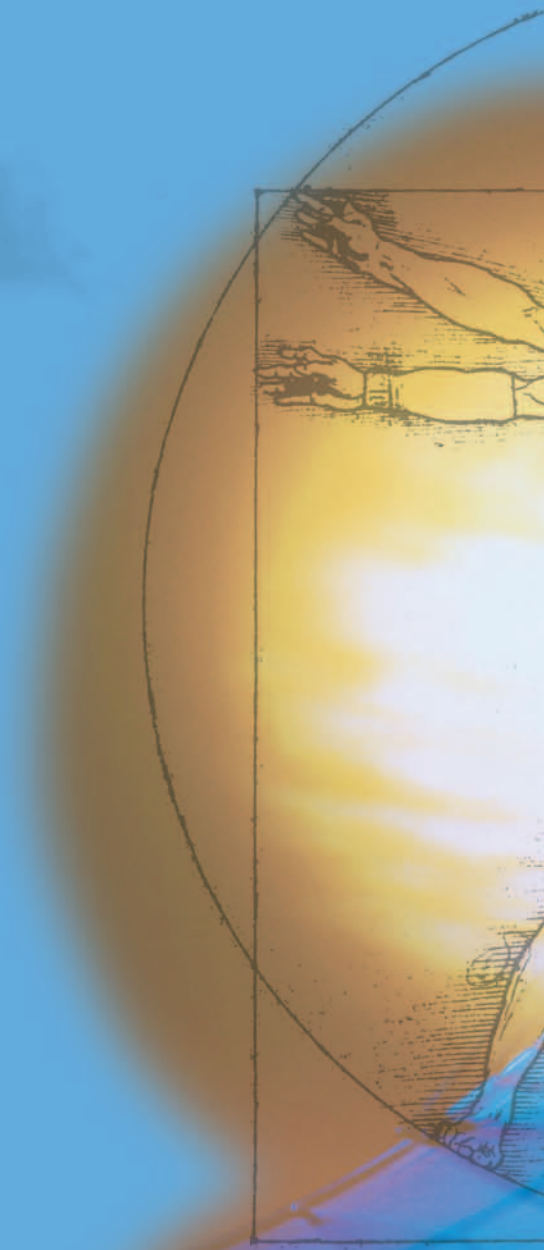

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