Measuring Progress:

A Guide to Assessing Students for Technological Literacy

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

ITEA Technology for All Americans Project (TfAAP)

TECHNOLOGY
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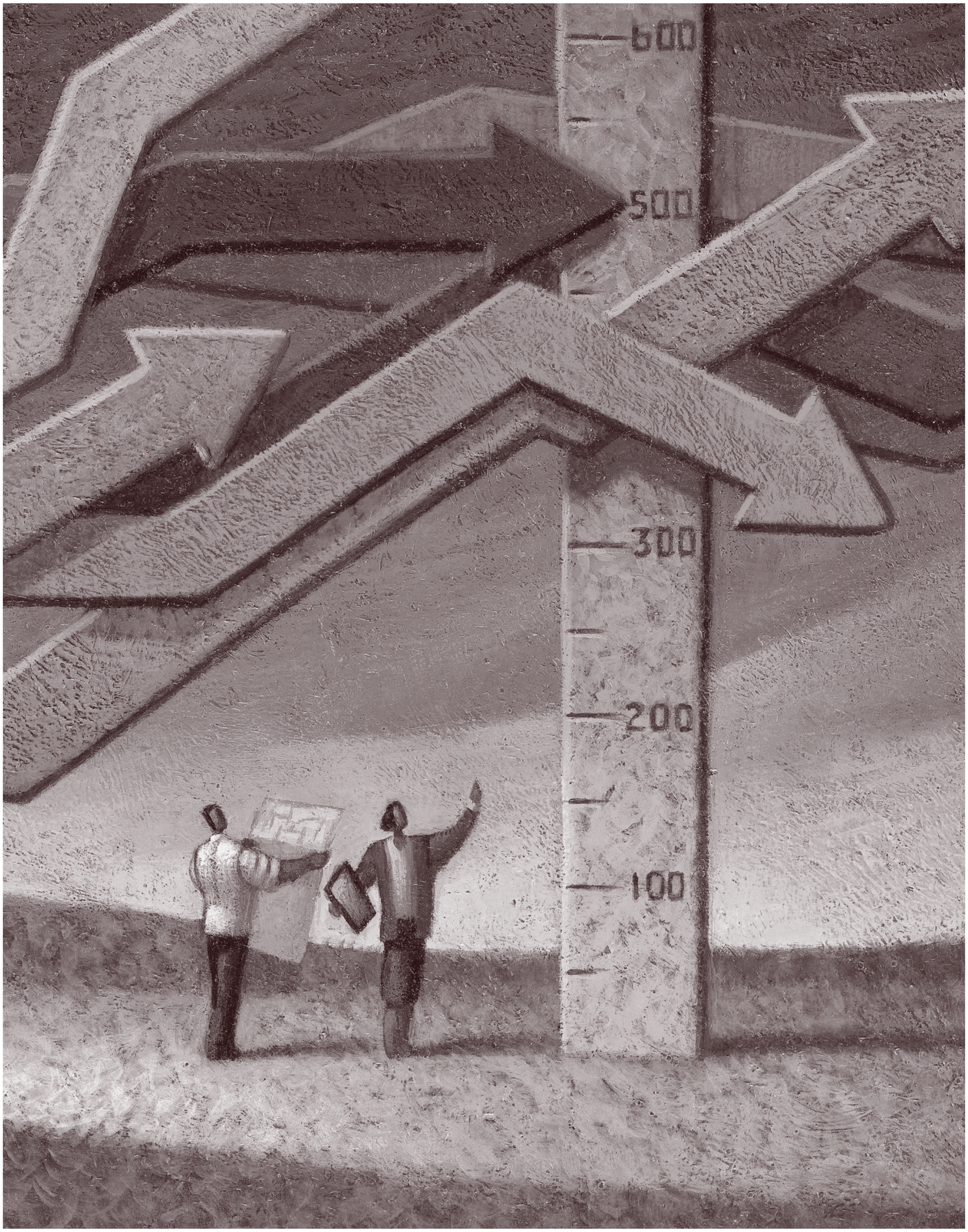
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Preface

With increased support for educational standards, teachers 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. *Measuring Progress: A Guide to Assessing Students for Technological Literacy* offers teachers an approach to standards-based student assessment of technological literacy.

ITEA originally developed *Measuring Progress* in 2002. Dr. Leonard Sterry wrote the first version of the document. It was field tested in ITEA's Center to Advance the Teaching of Technology and Science (CATTS) Consortium states around the country. In March 2003, ITEA's Technology for All Americans Project (TfAAP) released *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003). In the spring of 2003, ITEA made the decision to have the TfAAP staff revise *Measuring Progress* to align it more fully with the new student assessment standards in *AETL*. Lisa Delany re-wrote the document in the summer of 2003, working in close consultation with Dr. Sterry to maintain the original intent and contextual framework of the document. Several other individuals helped make this document possible, and acknowledgements are provided in Appendix A.

Measuring Progress is a resource for teachers to use as they plan and implement standards-based student assessment. Section 1 is an overview of how standards relate to assessing student technological literacy. Section 2 provides an approach to standards-based student assessment. Section 3 describes several assessment tools and methods. Section 4 details assessment principles that teachers should consider when designing student assessment. And Section 5 suggests some applications for assessment data as well as evaluation strategies for ensuring effective student assessment. There are also several resources in the appendices, including forms that can be photocopied for teachers to use as they work toward standards-based reform of student assessment in their own laboratory-classrooms.

Measuring Progress is most useful when users are already familiar with the technology content standards in *Standards for Technological Literacy: Content for the Study of Technology (STL)* (ITEA, 2000/2002) and the companion standards for student assessment, professional development, and program enhancement in *AETL*. However, teachers may use *Measuring Progress* as a bridge to understanding the vision of the standards as it pertains to student assessment. ITEA is developing additional addenda that examine topics such as standards-based programs, professional development, and curricula. ITEA welcomes feedback on all of the guides in this addenda series as we work together to encourage 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
- *Measuring Progress: A Guide to Assessing Students for Technological Literacy*
- *Realizing Excellence: A Guide for Exemplary Programs in Technological Literacy*
- *Planning Learning: A Guide to Developing Technology Curricula*
- *Teaching Technology: A Guide for Professional Development*

Standards-Based Technological Study Series

Elementary School Level Resources
- *Models for Introducing Technology: A Standards-Based Guide*
- *Technology Starters: A Standards-Based Guide*

Middle School Level Resources
- *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*
- *Teaching Technology: Middle School, Strategies for Standards-Based Instruction*

High School Level Resources

- *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*
- *Teaching Technology: High School, Strategies for Standards-Based Instruction*

Standards-Based Technological Study Units

Elementary School Level Resources

- 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*
- Kids Inventing Technology Series (KITS)

Secondary School Level Resources

- Humans Innovating Technology Series (HITS)

SECTION 1

Standards-Based Student Assessment of Technological Literacy

This section provides an overview of standards-based assessment of student technological literacy.

The study of technology is distinct and different from educational (instructional) technology, which utilizes tools, such as computers, audiovisual equipment, and mass media, to enhance teaching and learning in all school subjects.

Facilitating Technological Literacy

> We live in a technological world. Living in the twenty-first century requires much more from every individual than a basic ability to read, write, and perform simple mathematics. . . . Citizens of today must have a basic understanding of how technology affects their world and how they exist both within and around technology . . . . Students need and deserve the opportunity to attain technological literacy through the educational process. (ITEA, 2003, pp. 1-2)

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

Society is becoming increasingly dependent upon technology and technological advancements. We, as educators, need to prepare students with the knowledge and abilities needed to interact with the technological world. The promise of the future lies not in technology alone, but in people's ability to use, manage, assess, and understand it (ITEA, 1996; 2003). Students need to study technology to develop technological literacy.

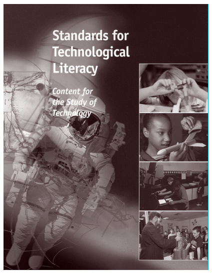
Technological literacy is the ability to use, manage, assess, and understand technology.

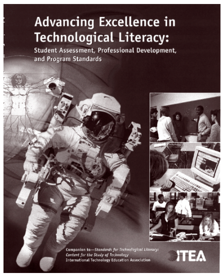
Educational standards offer a focused approach to education. The International Technology Education Association (ITEA) developed four nationally-recognized sets of educational standards on content, student assessment, professional development, and programs for the study of technology. These standards provide the basis for strong technology programs and can move the study of technology forward in a united national effort.

Educational Standards for Technological Literacy

Educational standards are statements about what is valued that can be used for making a judgment of quality (ITEA, 2000/2002). Every teacher of technology should be familiar with the standards for technology content, student assessment, professional development, and programs.

Standards for Technological Literacy: Content for the Study of Technology (*STL*) (ITEA, 2000/2002) provides the content basis for the study of technology. *STL* standards (see Appendix B) specify what every student should know and be able to do in order to attain technological literacy. The standards include the application of both knowledge and abilities to real-world situations.





However, content is not enough to ensure the effective study of technology. So, ITEA developed *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003). *AETL* is based on *STL*. Thus, *AETL* provides the means for implementing *STL* in the laboratory-classroom. *AETL* contains three separate but related sets of standards:

1. The student assessment standards (see Appendix C) identify criteria to ensure effective assessment of student technological literacy.
2. The professional development standards (see Appendix D) ensure effective and continuous in-service and pre-service education for teachers of technology.
3. The program standards (see Appendix E) detail criteria for technology program enhancement.

Measuring Progress will focus on the student assessment standards (see Table 1). However, in the big picture, student assessment is only one program component.

Table 1. Student Assessment Standards from *AETL*

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

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

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

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

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

Student assessment **refers to the process of collecting evidence on student learning, understanding, and abilities to inform instruction and provide feedback to the learner.**

Measuring Progress **examines student assessment as it applies to individual laboratory-classrooms. While ITEA recognizes the need to use large-scale assessment instruments to determine state and/or national student technological literacy,** ***Measuring Progress*** **does not discuss large-scale assessment. Large-scale assessment involves examining the learning of a large number of students, such as across a state/province/region or nation.**

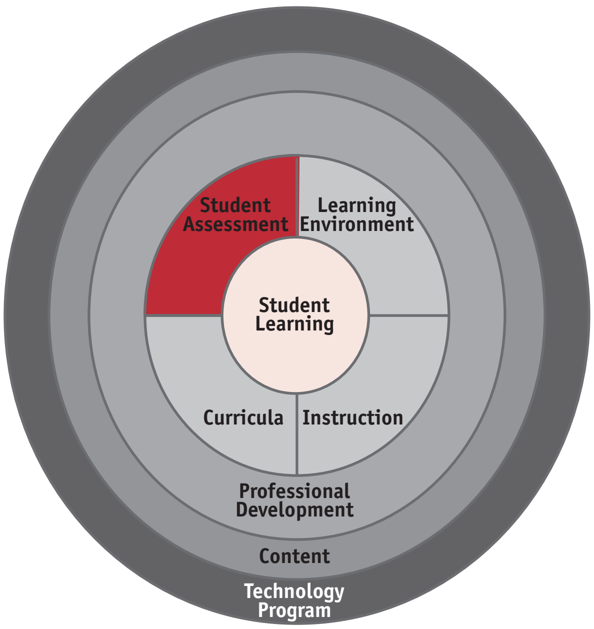
Content standards refers to the standards in _STL_. _Technological literacy standards_ refers to the standards in both _STL_ and _AETL_.

Connecting Student Assessment With Standards: The Big Picture

Planning and delivering standards-based student assessment requires that we pause, take a step back, and consider the big picture of the technology program in which we are teaching. *AETL* defines program as everything that affects student learning. This includes content, professional development, curricula, instruction, student assessment, and the learning environment, implemented across grade levels (see Figure 1).

Measuring Progress is intended to help teachers align student assessment with technological literacy standards. Additional ITEA addenda examine such topics as standards-based programs, professional development, and curricula.

Figure 1. Selected Program Components



Planning Standards-Based Student Assessment

Student assessment is the systematic, multi-step process of collecting evidence on student learning, understanding, and abilities and using that information to inform instruction and provide feedback to the learner, thereby enhancing learning (ITEA, 2003). Appendix F provides suggestions for teachers, administrators, and policymakers to consider as they answer the following fundamental questions of standards-based planning:

Where are we now? The answer to this question will depend upon how we respond to two intermediate questions: *What is the current level of student technological literacy in our laboratory-classrooms*? and *What is the current state of student assessment*? We need to examine how student assessment facilitates technological literacy in our classrooms, schools, and school districts. "If teachers are reasonably sure about what their students currently know, then teachers can more accurately tailor … [student assessment according] to what students need to know" (Popham, 1999, p. 2). "Where are we now" depends upon whether student assessment is standards-based and whether student assessment actually measures technological literacy.

Where do we want to go? We must identify the outcomes we want from teaching and learning—*what should graduates of our schools know and be able to do related to technology*? The standards to which a school or school district is committed can answer this question and may include national, state, and/or local standards. *STL* and *AETL* are the only nationally-accepted sets of educational standards for technological literacy. *STL* "does not prescribe an assessment process for determining how well students are meeting the standards, although it does provide criteria for such an assessment" (ITEA, 2000/2002, p. 13). *Measuring Progress* asserts that student assessment should be aligned with technological literacy standards.

How are we going to get there? Linking student assessment practices with standards requires more than showing that specific standards are being assessed. We have to consider the strategies that we will use to advance student technological literacy. Planning standards-based student assessment requires that we consider how we can best support students as they seek to attain technological literacy (Carr & Harris, 2001). The answer is a standards-based approach to teaching, learning, and student assessment. *Measuring Progress* is primarily intended to help teachers "get there."

What knowledge and abilities must educators possess to get there? Professional development, both pre-service and in-service, helps teachers "get there" by providing opportunities based on teachers' needs and, ultimately, the needs of their students. Appendix D is a listing of the professional development standards from *AETL*. Teachers and other educators should seek multiple opportunities to engage in comprehensive and sustained personal professional growth. In other words, teachers of technology need to remain current with the changing nature of technology and research in education.

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

How will we know when we have arrived? We will know that we have arrived when student assessment data show that students have reached the desired level of technological literacy. As we compare the evidence from student assessment with our teaching and learning expectations, we can make judgments about the level of understanding students have reached. If students do not perform well, we know that we need to evaluate the technology program and make revisions. Both successes and failures should be reported to program stakeholders. The goal is for all students to achieve technological literacy. Section 5 suggests some applications for assessment data as well as evaluation strategies.

A Word of Caution: Standards-Based vs. Standards-Reflected

Standards-***based*** assessment starts with content standards as a base, then develops specific learning goals, and then establishes assessment criteria against which understanding is judged. The real question becomes: *What do students know, do, and ultimately, understand*? By using a standards-based approach, student learning is assessed against criteria based on standards instead of program inputs, such as existing curricula and instruction. In other words, the teacher avoids the "checklist" trap of saying, "Oh, I'm already doing this," "I just talked about this yesterday," or "I covered this in the course introduction." It is important to note that for assessment to be standards-based, **the curricula and the instruction must also be based upon the assessment criteria**.

Standards-***reflected*** assessment starts with assessment tools and methods and attempts to make connections to the standards. In other words, standards become an afterthought and are not the basis for developing assessment practices. Standards-reflected assessment is misleading, because it gives the impression that practices are standards-based when they are not. Revising existing assessment tools and methods to show connections to standards **does not necessarily ensure that technological literacy is the intended outcome of assessment**. Standards-reflected assessment "… makes an explicit commitment to standards, but this … is not enough for planning standards-based learning. Too often the connections are weak or insufficient, consequently some standards get left out or the overall picture of standards implementation remains unclear" (Carr & Harris, 2001, pp. 18-19), such as in the "checklist" trap mentioned in the preceding paragraph. Table 2 provides a comparison of standards-based student assessment with standards-reflected student assessment.

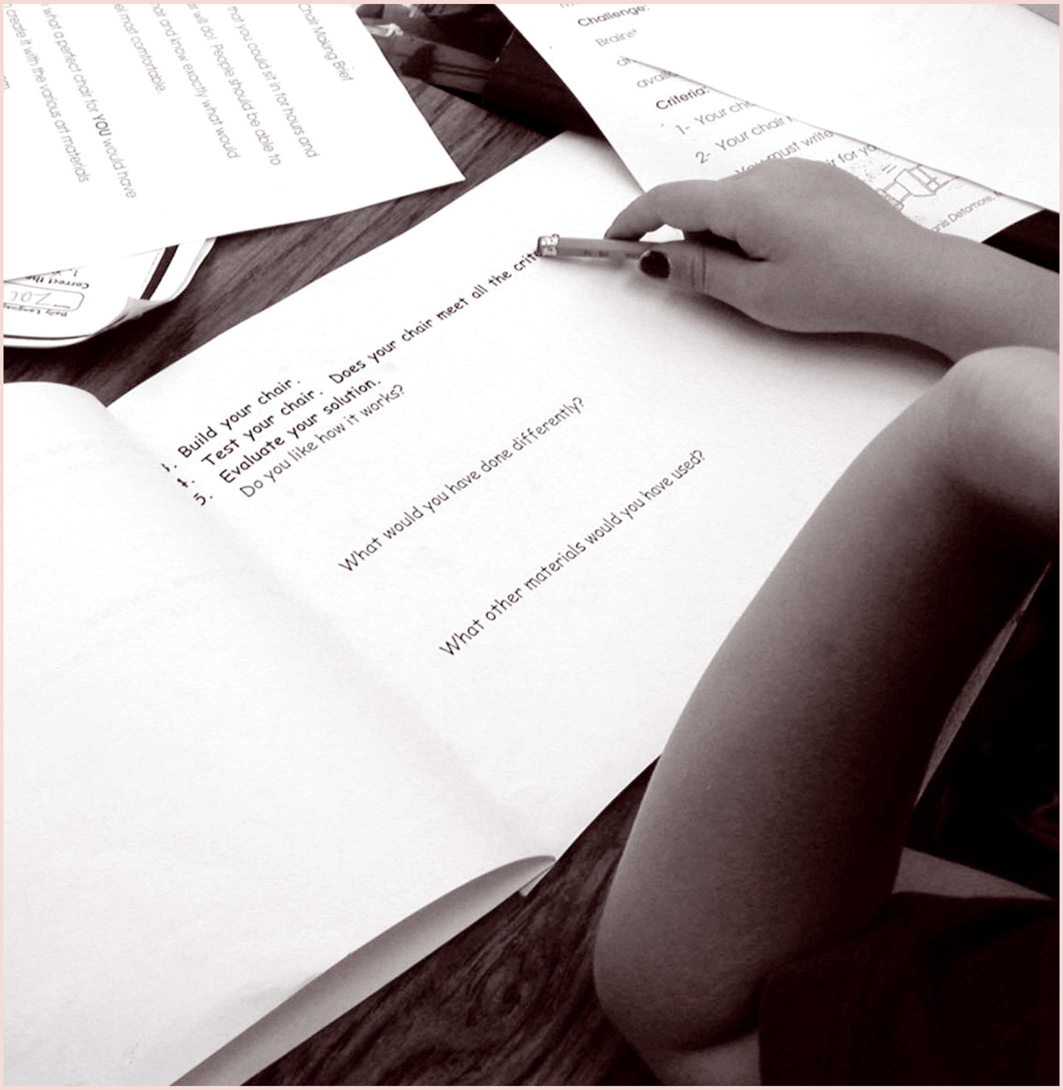
Table 2. Comparison of Standards-Based Assessment with Standards-Reflected Assessment

Standards-Based Student Assessment	Standards-Reflected Student Assessment
1. Identify *STL* standards and benchmarks to serve as basis for the content to be assessed. 2. Consider *AETL* standards and guidelines. 3. Define assessment criteria—"what a student should look like." 4. Identify an assessment tool or method that will deliver content in a manner consistent with *AETL*. 5. Develop lessons or activities to deliver *STL* content. 6. Gather evidence of student learning, using the selected assessment tool or method.	1. Start with a lesson or activity. 2. Identify the content being delivered by the lesson or activity. 3. Identify *STL* standards and benchmarks that might align with the lesson or activity content. 4. Select an assessment tool or method. 5. Consider how the selected tool or method addresses *AETL* standards.
Result: Student assessment that measures technological literacy consistent with *STL* & *AETL*.	**Result:** Student assessment that measures technological literacy when a "match" can be made between the lesson content and *STL* standards.

Sharing the Vision

Aligning student assessment with standards may seem overwhelming at first. But with a shared vision for developing technologically literate students, everyone—students, teachers, parents, administrators, and communities—can work together to help all students attain technological literacy through K–12 education.

SECTION 2
An Approach to Standards-Based Student Assessment



This section provides an approach to standards-based student assessment with step-by-step instructions. The approach is applied to the course and unit levels of teaching and learning. A similar approach may be used at the program level.

Imagine a laboratory-classroom where student assessment not only *measures* technological literacy but also *advances* it. Student assessment provides students with opportunities to solve practical, real-world problems relevant to the concerns of society. Student assessment incorporates multiple standards from *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002) and highlights the interrelationships among technologies and the connections between technology and other disciplines. Student assessment engages students in hands-on, minds-on activities that foster critical thinking, decision making, and problem solving related to the use, management, and evaluation of the designed world. In such a classroom or laboratory, student assessment occurs as an integral part of teaching and learning, and assessment results improve the teaching and learning process for all students.

Both *STL* and *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL*) (ITEA, 2003) assert that the study of technology must occur in a comprehensive, articulated fashion from kindergarten through Grade 12. Students learn basic technological concepts at the early elementary level and build upon knowledge and abilities at the middle and high school levels. Student assessment provides evidence that learning is facilitated across grade levels and disciplines by occurring "… in conjunction with the ongoing nature of the study of technology throughout Grades K–12" (ITEA, 2003, p. 21).

We should not view student assessment as an event—a single moment-in-time test—but as a varied collection of evidence over time (Wiggins & McTighe, 1998).

Holistic Assessment: A Collection of Evidence

We should not view student assessment as an event—a single moment-in-time test—but as a varied collection of evidence over time (Wiggins & McTighe, 1998). Therefore, we must view student assessment as a process. It involves quantifying, describing, observing, reporting, and giving feedback. It needs to be practical and manageable. Most importantly, the process should assist students in attaining technological literacy by being standards-based.

***Evidence* refers to the information collected that demonstrates or proves student understanding.**

Figure 2 illustrates a step-by-step (or multi-step) approach to a standards-based student assessment process. The approach does not look at any single assessment instance to determine student understanding. Instead, it requires educators to look at a collection of assessment results to arrive at a holistic judgment of student understanding. While the approach presents five steps, experienced teachers know that organizing teaching and learning does not always occur in a linear fashion. As teachers become comfortable planning standards-based student assessment, they will revisit and re-examine steps to help thoroughly link student assessment to technological literacy standards.

It is important to note that the steps at the course level and unit level are identical in the approach presented in Figure 2. A *course* lasts for a specified period of time (e.g., semester, year) and is designed around a specific school subject. Courses are composed of units. A *unit* is an organized series of learning activities, lectures, projects, and other teaching strategies that focuses on a specific topic related to the course curriculum (ITEA, 2003).

Figure 2. An Approach to Standards-Based Assessment of Technological Literacy

COURSE LEVEL

Step 1. Identify content standards, then select benchmarks.
Step 2. Extract and organize content.
Step 3. Define assessment criteria.

UNIT LEVEL

Unit #3*

Unit #2

Unit #1

Step 1. Identify content standards, then select benchmarks.
Step 2. Extract and organize content.
Step 3. Define assessment criteria.
Step 4. Select and use assessment tools/methods.
Step 5. Make use of assessment results

**Note: The number of units in a course will depend upon how content is extracted and organized in Step 2 at the course level.*

Step 4. Select and use assessment tools/methods.
Step 5. Make use of assessment results.

The standards-based assessment approach incorporates the backward design concept (Wiggins & McTighe, 1998).

The steps that follow will lead you through the approach in Figure 2. It is extremely important to identify whether you are planning at the course level or unit level. When working at the unit level, Steps 1–3 will be based upon your responses to Steps 1–3 at the course level. Please photocopy Appendix H (for course level planning) or Appendix I (for unit level planning) and fill it in as you complete Steps 1-5, which follow. If you do not have a copy of *STL*, you may view the content standards online at http://www.iteawww.org.

The term *content standards* here and elsewhere in *Measuring Progress* consistently refers to the standards in *STL*. The text that follows will also indicate alignment with the student assessment standards in *AETL*. Additionally, a vignette is embedded within the text to provide a "snapshot" of how a teacher might apply the standards-based approach to student assessment in his or her laboratory-classroom. Please see page 14 for an example.

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

Step 1: Identify Content Standards, Then Select Appropriate Benchmarks

Begin with a clear picture of what you want by identifying the content standards that will guide student assessment in your laboratory-classroom. The standards in *STL* define what students should know, be able to do, and ultimately understand about technology in a very broad sense. Standards provide direction and a spirit of intent, not a complete list of important concepts. It is not necessary to address all 20 standards in any given unit, course, or grade. However, it is necessary to address all of the *STL* standards and benchmarks within a grade "band" (K–2, 3–5, 6–8, or 9–12).

It is vital to begin by looking at the standards, rather than the benchmarks that follow the standards, to capture the breadth of content in *STL*. The content standards that are selected should integrate in a way that will enable you to deliver variety in technological content (AETL *Student Assessment Standard 4, Guideline B*).

Prior to applying this approach to an individual course or unit, you will need to work with teachers across grade levels and disciplines to ensure that each of the standards is addressed at increasing levels of complexity each time the content is encountered. In addition to identifying which technology content standards will be taught and assessed, you will benefit by documenting other content area standards that will be addressed (AETL *Student Assessment Standard 1, Guidelines A & B*). You may find it helpful to use the Responsibility Matrix Form provided as Appendix G. Please see the vignette on page 14 for an example.

Once you have identified the standards you will assess in your course or unit, record them appropriately on your Standards-Based Student Assessment Form. If you have completed a Responsibility Matrix Form, you will need to reference it to address those standards for which you and your students will be held accountable. Obviously, if you are working at the course level, you will select more standards and benchmarks than you will at the unit level. **It is generally recommended that you assess no more than two or three standards in each unit.**

Once you have selected content standards, you will then choose the benchmarks that "uncover" concepts necessary to develop an understanding of those standards. Benchmarks in *STL* are provided in grade bands (K–2, 3–5, 6–8, and 9–12). Benchmarks should add detail to the concepts that will be taught and assessed. As with the content standards, students do not need to encounter every benchmark at each grade level within a grade band, within each course, or within each unit. **Please record the benchmarks that you will address on your Standards-Based Student Assessment Form.** The vignette on page 15 provides an example.

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)**

Vignette

Snapshot of the Approach in Action

Note: *The vignette is intended to provide a snapshot of the approach taken to align student assessment with technological literacy standards. It provides examples. It does not provide a comprehensive examination of each step.*

Ms. Toledano, a 6^{th} grade technology teacher, is interested in aligning student assessment in her laboratory-classroom with technological literacy standards. She begins by working with other teachers to identify the grade levels at which individual standards will be taught and assessed. Using the Responsibility Matrix Form (Appendix G in *Measuring Progress*), she develops a matrix to document teacher responsibilities for addressing the content standards in *STL* as well as related content standards in other disciplines (see Figure 3).

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 Level Classrooms					Technology Laboratory-Classrooms				
	K	**1**	**3**	**4**	**5**	**6**	**7**	**10**	**11**	**12**
***STL* 1.** Students will develop an understanding of the characteristics and scope of technology.	X	X	X	√	O	X	v	X	√	√
***STL* 2.** Students will develop an understanding of the core concepts of technology.	√	√	O	O	X	√	X	X	O	√
***STL* 3.** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	√	√	O	X	X	O	X	√	√	X
***STL* 4.** Students will develop an understanding of the cultural, social, economic, and political effects of technology.	O	√	O	X	√	O	√	O	O	√
***STL* 5.** Students will develop an understanding of the effects of technology on the environment.	O	O	√	O	X	O	O	X	O	O

Figure 3

Vignette, *Continued*

In planning her course, Ms. Toledano reviews her Responsibility Matrix Form and consults *STL* to identify the content standards she will address. She looks to the benchmarks for further detail. Ms. Toledano records the standards and benchmarks she intends to teach and assess in her course on the Course Level Standards-Based Student Assessment Form (see Figure 4).

APPENDIX H

Course Level
Standards-Based Student Assessment Form

Step 1. SELECT CONTENT STANDARDS, THEN IDENTIFY BENCHMARKS
Identify and document the content standards that will serve as the basis for student assessment. Then select the benchmarks that add detail to the concepts that will be taught and assessed. Multiple copies of this page may be needed.

STOP! And confirm: Review the selected content standards and benchmarks to verify that they *include variety in technological content.*

Step 2. EXTRACT AND ORGANIZE CONTENT
What are the specific understandings students should possess having engaged in the content of the standards and benchmarks? What are the big ideas students should learn to ultimately understand the standards and benchmarks?

<table>
<tr><th>Content Standard</th><th colspan="3">Benchmark</th></tr>
<tr><td rowspan="2">STL 6. Students will develop an understanding of the role of society in the development and use of technology.</td><td colspan="3">Benchmark D.
Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.</td></tr>
<tr><td>Big Idea:</td><td>Big Idea:</td><td>Big Idea:</td></tr>
</table>

Figure 4

SECTION 2

Step 2: Extract and Organize Content

As detailed as the benchmarks are, they may need additional interpretation. From the benchmarks, you must identify and document the enduring concepts or "big ideas" that students should learn so they will ultimately understand the standards and benchmarks in *STL*. "The term *enduring* [concept] refers to the big ideas, the important understandings, that we want students to 'get inside of' and retain after they've forgotten many of the details" (Wiggins & McTighe, 1998, p. 10).

In some instances, the enduring concepts may be the benchmarks themselves; in other instances, the enduring concepts may be derived from elements of the benchmark. For example, *STL* Standard 2, Benchmark N states: "Systems thinking involves considering how every part relates to others." This benchmark could serve as the big idea to be learned. By contrast, *STL* Standard 17, Benchmark L states: "Information and communication technologies include the inputs, processes, and outputs associated with sending and receiving information." In this instance, the big ideas might include individual examination of inputs, processes, and outputs.

You might find it helpful to answer the question: *What are the specific understandings students should possess having engaged in the content of the standards and benchmarks*? We must provide students with opportunities for critical thinking and decision making (AETL *Student Assessment Standard 4, Guideline C*). We need to be able to gather evidence of student learning within the cognitive, psychomotor, and affective learning domains (AETL *Student Assessment Standard 1, Guidelines C, D, & E*). Additionally, we should provide students with opportunities to engage in technological problem solving—design, engineering design, troubleshooting, research and development, invention and innovation, and experimentation (AETL *Student Assessment Standard 4, Guideline A*).

Record the big ideas that you will address on your Standards-Based Student Assessment Form. Please see the vignette on page 17 for an example.

Vignette, *Continued*

After completing Steps 1–3 of her course level planning, Ms. Toledano decides that the selected standards could be addressed in a unit on forensics. She has already completed Steps 1 and 2 by choosing appropriate standards and benchmarks from her course level planning form. To complete Step 3, Ms. Toledano extracts the important understandings from the standards and benchmarks she selected. She records these ideas on the Unit Level Standards-Based Student Assessment Form (see Figure 5).

APPENDIX I
Unit Level
Standards-Based Student Assessment Form

Step 1. SELECT CONTENT STANDARDS, THEN IDENTIFY BENCHMARKS
Identify and document the content standards that will serve as the basis for student assessment **by re-examining Steps 1 and 2 at the course level.** Then select the benchmarks that add detail to the concepts that will be taught and assessed.

STOP! And confirm: Review the selected content standards and benchmarks to verify that they *include variety in technological content.*

Step 2. EXTRACT AND ORGANIZE CONTENT
What are the specific understandings students should possess having engaged in the content of the standards and benchmarks? What are the big ideas students should learn to ultimately understand the standards and benchmarks?

Content Standard	Benchmark		
STL 6. Students will develop an understanding of the role of society in the development and use of technology.	*Benchmark D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.*		
	Big Idea: *DNA technologies available for use today provide greater efficiency and accuracy than previously used technologies.*	Big Idea: *Economic, political, and cultural issues influence the selection and use of technologies for forensic investigation.*	Big Idea:

Figure 5

Step 3: Define Assessment Criteria

Evidence **refers to the information that demonstrates or proves a level of understanding. Teachers collect evidence of student learning and judge that evidence against assessment criteria to identify the attained level of technological literacy in relation to the content standards.**

Assessment criteria are indicators that suggest the level of understanding attained by students. Assessment criteria provide the basis for teaching and learning by capturing the essential ingredients of the content being measured. They are written to provide cues to you and your students about what significantly indicates student technological literacy. **Curricula, instruction, assessment tools and methods, and the learning environment are developed *after* assessment criteria have been established and are based on the assessment criteria.** You will use the assessment criteria to judge student understanding—a collection of evidence over time—to determine the level of student technological literacy.

As assessment criteria are established, we must consider that student learning will be influenced by a variety of factors including student commonality and diversity —interests, cultures, abilities, socio-economic backgrounds, and special needs. To allow for student commonality and diversity and the reality that all students will not attain a consistent level of understanding all of the time, we must delineate assessment criteria at varying levels to accurately assess student progress toward technological literacy.

To write the assessment criteria, begin by examining the big ideas. Ask yourself, *what should my students look like having learned the big ideas*? This might be considered the acceptable or "at target" level of understanding. Then specify criteria for learning that exceed your expectations, or are "above target." And finally define criteria that do not meet your expectations or are below your expectations, which might be considered "below target." Thus, the assessment criteria will be written for at least three levels of understanding. The Standards-Based Student Assessment Forms provide matrices for writing assessment criteria differentiated at three, four, and five levels. **Choose which matrix you will use, and record the assessment criteria on your Standards-Based Student Assessment Form.** Alternatively, you may choose to develop and use a matrix of your own. Please refer to the vignette on page 19 for an example.

Ms. Toledano is ready to complete Step 3 for her unit on forensics. Examining "Big Idea: DNA technologies available for use today provide greater efficiency and accuracy than previously used technologies," she establishes and records assessment criteria on her Unit Level Standards-Based Student Assessment Form (see Figure 6). She categorizes the levels of understanding as "above target," "at target," and "below target."

Note: The form below provides only one example of assessment criteria appropriate for Ms. Toledano's unit. A fully-developed form would likely contain more assessment criteria.

Step 3: DEFINE ASSESSMENT CRITERIA
What are the expectations for student learning? Define criteria at levels which meet, exceed, and fall below your expectations.

NOTE: Defining assessment criteria at various levels requires that you first determine the number of levels that will be assigned. You may choose to use any of the three tables that follow or develop one of your own.

Big Ideas	Assessment Criteria		
	Below Target	**At Target**	**Above Target**
DNA technologies available for use today provide greater efficiency and accuracy than previously used technologies.	*Identification of DNA technologies currently in use for forensic investigation.*	*Identification of DNA technologies currently in use for forensic investigation compared with those available 15 years ago.*	*Identification of DNA technologies currently in use for forensic investigation compared with those available 15 years ago. Evidence of research of DNA technologies to be available in the future.*

Figure 6

Step 4. Select and Use Assessment Tools and/or Methods

You will need to use a variety of assessment tools and methods to accurately determine student understanding. You will be able to collectively examine the evidence from those individual tools and methods in light of the assessment criteria you developed in Step 3 to judge overall student technological literacy. Selection of tools and methods should be based on the content being assessed and the type of evidence being gathered. There are many individual assessment tools and methods available, and Section 3 of *Measuring Progress* describes several of them. Also, there are several general principles that are vital to the application of any individual assessment practice. These are explained in Section 4.

Identify and record the tools and methods that you will use to gather evidence of student understanding on your Standards-Based Student Assessment Form.

Comparison with the backward design process outlined by Grant Wiggins and Jay McTighe (1998) may reveal a seeming discrepancy in the order of Steps 3 and 4. However, there is no discrepancy, as the Wiggins and McTighe process is applied on a smaller scale, at the level of designing individual assessment instances, whereas the approach put forth in *Measuring Progress* enables those individual assessment instances to be based upon the overall assessment criteria for the course or unit.

Photo courtesy of Gary Wynn

Step 5. Make Use of Assessment Results

After Steps 1–4 have been applied through the teaching and learning process, you will be able to make judgments about what your students learned by comparing the evidence collected to the assessment criteria. You may find it helpful to consider the questions: *Are my students technologically literate? Did my students learn what I intended them to learn? Why or why not?* The assessment criteria define aspects of student technological literacy. By examining the evidence as a whole—rather than considering the individual instances of evidence gathering—you will be better able to determine overall student technological literacy.

It is important to note that this process is not the same as the process of assigning grades. If the students do not "measure up" to the assessment criteria, there may

Photo courtesy of Gary Wynn

SECTION 2

be reasons that have little to do with student ability or effort, such as a need to adjust curricula or instruction. While assigning grades is a necessary part of the teaching process, *Measuring Progress* does not focus on grading *per se*. *Measuring Progress* asserts that student assessment should be used to advance student technological literacy, not simply as a process for judging it.

Document how you will use student assessment results for your course or unit on your Standards-Based Student Assessment Form. You may choose to do this before delivering the course, or you may do this after you see the results of student assessment—or preferably both.

Assessment is an empty process unless the results are used to make positive change. Teachers assess students to improve teaching and learning; however, the results may be used in a variety of ways:

- Improving teaching and learning.
- Assigning grades.
- Monitoring progress.
- Identifying levels of technological literacy.
- Determining instructional effectiveness.
- Communicating results.
- Marketing and promotion.
- Guiding professional development decisions.
- Guiding program enhancement decisions.

Section 5 details some other applications for assessment data as well as suggestions for evaluating the approach used to assess students (see Appendix J).

SECTION 3
Student Assessment Tools and Methods

This section describes several assessment tools and methods. Student technological literacy may be assessed using additional tools and methods that are not mentioned here. In any case, the tool or method selected must show or provide evidence of student learning.
Note: All individual assessment tools and methods must adhere to the assessment principles presented in Section 4.

"While the data produced by student assessment are used by many people for a variety of purposes, the primary purpose of assessment should be to improve teaching and learning." (ITEA, 2003, p. 18)

SECTION 3

Traditionally, the need to assign grades has been a major reason for assessing students. The National Research Council's (NRC) report, *Knowing What Students Know: The Science and Design of Educational Assessment* (2001b) indicates that the three broad purposes of assessment include 1) assisting learning, 2) measuring individual achievement, and 3) evaluating programs. "While the data produced by student assessment are used by many people for a variety of purposes, **the primary purpose of assessment should be to improve teaching and learning**" (ITEA, 2003, p. 18), which corresponds with NRC Purposes 1 and 2 above.

Measuring Progress asserts that we should use student assessment to monitor student progress toward technological literacy and to enhance teaching and learning.

Gathering Evidence

We use assessment tools and methods to collect evidence of student learning. Different tools and methods are used in different situations. **The use of any single assessment practice is not adequate**. Students have different levels of intelligence, learning styles, and capabilities. They demonstrate achievement in different ways. Therefore, students should be assessed often using a variety of tools and methods. We compare the collective evidence gathered by individual student assessment tools and methods with the assessment criteria (see Step 3 in Section 2). In this way, we can determine student technological literacy over time, for example, over the duration of a unit or course.

Individual instances of evidence gathering (i.e., multiple-choice tests, student portfolios, etc.) will be examined separate and apart from the holistic examination of the collective evidence gathered throughout teaching and learning. Section 3 focuses primarily on the individual instances of evidence gathering, whereas Section 2 describes a more holistic approach to student assessment.

As we review the evidence gathered by the tool or method and compare it to the assessment criteria, we must judge the evidence based upon established parameters that reflect our expectations for learning. Scoring devices, such as rubrics, are useful to establish these parameters. The use of scoring devices is further discussed at the end of this section.

Selection of individual assessment tools and methods is based on the content, the purpose, and the audience for assessment results. Therefore, **before any specific tool or method can be designed, we must identify the purpose and the audience of the assessment tool or method**.

Purpose of Assessment

The assessment purpose should be driven by the evidence of student understanding to be gathered as well as the intended use of student assessment results. Before designing an individual tool or method, we should write a purpose statement to clarify our intentions and ensure that the tool or method selected is appropriate to the type of evidence needed. We might use a multiple-choice test to assess student *knowledge of design terminology*, whereas we would more likely

select a model or prototype to assess student *abilities to apply the design process*. We must also make the assessment purpose and learning expectations clear to our students (AETL *Student Assessment Standard 2, Guideline A*).

Additionally, the purpose of the tool or method should be driven by how we intend to use the results of the assessment practice. If we clarify in advance that the purpose of the assessment instance is to, for example, quickly check that our students are "getting it" before moving the lesson forward, we would choose a formative assessment tool or method over one that is summative in nature. Likewise, if our purpose is to assess the level of student technological literacy at a given point in time, we would be more likely to select some summative measure.

Audience for Assessment Results

Assessment results may be used to inform individuals and groups of progress educators are making toward developing a technologically literate populace. The audience for a specific assessment tool or method should be clearly stated and considered in the process of development (AETL *Student Assessment Standard 2, Guideline B*). Please note that *audience* refers to those who will see the assessment data, not those who will use the assessment tool or method. Table 3 lists various audiences for assessment results and gives examples of the information needed by those audiences.

Table 3. Audiences for Assessment Results	
Audience	**Information Need(s)**
Students	How close am I coming to my potential ability? How am I doing in school (relative to the study of technology)? Will I meet graduation requirements? Am I prepared to obtain my career goal?
Parents	How well is my child doing in school? Are there areas where I can help her/him attain technological literacy?
Teachers	How are my students doing? What adjustments do I need to make in my instruction to ensure that my students attain technological literacy? Are all of the content standards and benchmarks in *STL* being addressed? Do classroom practices reflect all of the standards and guidelines in *AETL*?
Department Chairs	What support must I provide to the teachers to help them enhance student learning? Are all of the content standards and benchmarks in *STL* being addressed? Do classroom practices reflect all of the standards and guidelines in *AETL*?
Principals	How are students in my building meeting technological literacy standards? Where have we shown improvements in technological literacy learning? Where should I focus resources to improve technological literacy learning in this school?
Curriculum Coordinators	What gaps remain in our district's curriculum with respect to technological literacy standards? Which instructional programs are most effective? What are the professional development needs of district staff?
Local District Superintendents	How well are the schools in my district assisting students in attaining technological literacy? Which programs need to be revised? What resources are needed to improve student technological literacy learning across the district?
Local School Boards	Is our district using its resources to advance student technological literacy? What improvements are needed in our schools?
Taxpayers	How well are the schools in my community preparing students to function as responsible, technologically literate adults?
Business & Industry	To what extent are students technologically literate and prepared for the world of work? Will our workforce continue to be competitive in a global economy?
State Superintendents	What programs can the state's educational system provide to support technological literacy learning in our schools?
State Boards of Education	Is the state making the best use of its resources to support student technological literacy learning?
Colleges & Universities	How well prepared are students to continue their formal education with respect to the study of technology?
Educational Researchers	What factors influence the study of technology in our schools? What programs are needed to improve technological study in our schools?
State Policymakers (Legislators & Governors)	What evidence is available to show the effectiveness of statewide educational policy with respect to technological literacy? What do state level indicators tell us about our state's educational policies as they relate to technological literacy?
National Leaders	How do states compare to each other in the development of technological literacy? How do our students compare to those in other countries? What nationwide educational programs are needed to strengthen student technological literacy?
Society	ALL OF THE ABOVE

(Levande, 2001, September, adapted with permission)

Selected Assessment Tools and Methods

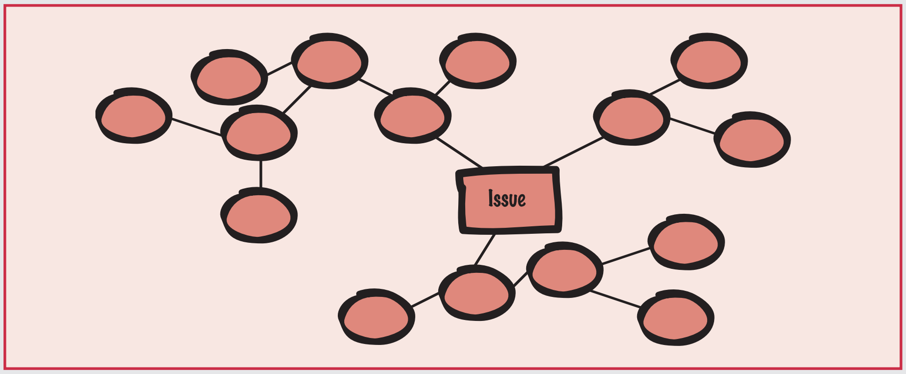
The assessment tools and methods that follow are presented alphabetically and are summarized by:

- *Description* – Brief overview of the tool/method.
- *Guidelines* – Some suggestions to consider as the tool/method is developed.
- *Advantages* – Strengths to consider in selecting the tool/method.
- *Limitations* – Precautions to consider in selecting the tool/method.

Concept Mapping

Description. A concept map, also referred to as a “web” or “graphic organizer,” is a representation that students create to detail relationships among ideas (see Figure 7). An event or issue is written at the center of the concept map. Students brainstorm answers to the question, “if this, then what?” They are instructed to show relationships among the ideas by connecting the concepts with lines.

Figure 7. Sample Concept Map



Guidelines

- Present students with a general concept.
- Ask students to brainstorm as many ideas as they can that relate to the concept. Students might begin by answering the question: *What do I know about the concept*?
- Have students arrange their brainstormed ideas into groups, so that the elements of a group represent similar ideas. Groups of words should be labeled with terms that define all of the elements of a particular group. Some or all of the brainstormed ideas may not fit into any group. Students will write these ideas into circles on the graphic.
- Have students connect similar ideas (groups) with lines to show a relationship. Every idea should be connected to another idea in some fashion.
- Concept mapping is a creative process without a distinctive beginning, middle, or end. Individual students will approach it differently.

Advantages

- Allows students to consider the “big” picture by making connections between new information and prior knowledge.
- Enables students to illustrate how they have “made sense” of the concept.
- Can provide direction for future learning activities based on student understanding and/or misunderstanding.
- Relatively quick way to determine “where” students are and assess progress.

Limitations

- Concepts and/or ideas presented may be vague.
- Students may not identify as many concepts as necessary for getting a good look inside their ways of thinking about a concept.

Debate

Description. A debate is an open discussion "for" or "against" an issue or question. This issue or question is often controversial so that opposing views can be presented. The viewpoints presented, however, should be based on researched evidence. Debates are usually conducted between two teams of three or four students, who perform in front of a classroom audience.

Guidelines

Prior to the debate:

- Select a debate topic that is current, relevant, appropriate to students, and researchable with existing resources.
- Provide students with the debate "logistics"—purpose, rules and procedures, and time allotted for conducting research.

During the debate:

- A moderator states the problem to both teams.
- Five minutes are provided to each team for formal presentations (affirmative, then negative).
- Five minutes are provided to each team for rebuttals (affirmative, then negative).
- The moderator requests questions and/or contributions from the audience (affirmative, then negative; repeat as needed).
- Three-minute summary speeches are given by each team (affirmative, then negative).
- The moderator opens the floor to questions. The debate team members and the audience are provided equal opportunities for participation.
- The moderator summarizes any new information presented.

Advantages

- Supports student learning of controversial topics.
- Allows students to draw their own conclusions.

Limitations

- "In-depth" learning of the topic only by the students engaged in research.
- Objective assessment may be difficult.

(Adapted from Henak, 1988, p. 150)

Demonstration / Presentation

Description. A demonstration is an active presentation. It generally enables students to *show* how something is done or how a particular thing or concept operates. A presentation is more formal than a demonstration. It is a structured communication with limited interaction. A presentation allows students to *tell* about the concept or process. Visual aids, such as audiovisual media, are often used in both demonstrations and presentations.

Guidelines

- Provide students with a list of expectations for their demonstrations/presentations.
- Inform students of the importance of preparation—spending sufficient time practicing, having all needed materials and tools available and in place before the demonstration/presentation, etc.
- Encourage each student to use visual aids so that all students in the audience can see the demonstration/presentation.
- Provide feedback to students during the demonstration/presentation by asking questions.

Advantages

- Enables students to demonstrate their abilities or inform others of their understanding.
- Can replicate "real world" situations.
- Can be used to assess a range of topics.

Limitation

- Requires substantial amount of time in comparison to some other tools and methods.

(Adapted from Hill, 1988, pp. 140–141)

Design Brief

Description. A design brief is a written plan that engages students in the design problem-solving process. Design briefs generally present students with a situation and ask them to solve a life problem. Students use the design process to make decisions and produce plans to convert resources into products or systems that meet human needs and wants or solve problems.

Guidelines

- Identify an appropriate context for the design problem. The context should describe a life situation that connects to the students.
- Define the challenge by describing the problem to be solved.
- Identify the criteria and constraints, or requirements and limitations. Criteria are desired specifications of a product or system. Constraints are limitations to the design process, and may include appearance, funding, space, materials, and human capabilities (ITEA, 2000/2002).
- Specify the resources that students may use as they generate a solution to the problem.
- Indicate criteria that students should use to evaluate their design to determine whether or not the proposed solution solves the problem and meets the requirements of the design brief.

Advantages

- Students solve a problem in an organized and analytical manner.
- Provides in-depth insight into student understanding and learning.
- Causes students to consider various criteria and constraints.

Limitation

- Defining a meaningful problem can be difficult.

(Adapted from Wright & Brown, 2004)

Discussion / Interview

Description. Discussion provides an opportunity for teachers to interact with students and to listen to students as they interact with each other. Teachers can query students, coaching them, causing them to realize that situations should be viewed from multiple perspectives. Teachers can find out what students know and what misconceptions students possess. Students are required to express their viewpoints, not just their knowledge. Teachers can make judgments about student understanding as they listen to students "make sense" of topics, issues, or content. Teachers can use open-ended questioning to initiate discussion (see p. 36).

While discussion is relatively informal, an interview is more structured. It includes a planned sequence of questions, similar to a job interview. Teachers collect data on student knowledge and abilities at a certain point in time by soliciting student responses to a series of questions. Interviews may be conducted with individual students or groups of students.

Guidelines

- Ensure that the classroom atmosphere is inviting to student discussion. Students should feel free to share or not to share their ideas, viewpoints, and opinions.
- Identify probing questions in advance to guide the discussion or interview. This will prevent the conversation from straying.
- Ask specific questions. Do not accept absolute responses such as "yes" or "no," or generalities such as, "it was too hard" or "it was fun." Require students to offer explanations that validate their opinions.
- Encourage participation by many students. Discourage a few students from dominating the discussion.
- Engage students in discussion regularly, throughout an activity, lesson, unit, etc.
- Record feedback.
- Utilize feedback to determine necessary instructional adjustments.

Advantages

- Offers potential to engage the entire class in discussion.
- Provides an opportunity for students to critically think about the content.
- Students can learn from each other.
- Students learn on their own by vocalizing their understandings and justifying their arguments.

Limitations

- Requires a substantial amount of time in comparison to other, more direct approaches.
- Potential to stray from the subject matter.
- Some students may participate more often than other students.

(Adapted from Jones, Bagford, & Wallen, 1979)

Journal / Log

Description. A journal or a log is a collection of written, periodic (daily/weekly) entries that document learning. Students may use journals or logs as a record of understanding, reflection, and/or opinion. Students may choose to include student summaries, drawings, or reports. Teachers may require students to reflect on and respond to a given prompt, such as, *how would your life be affected if transportation systems became obsolete*, or simply allow students to document their own thoughts or understandings. A journal may be part of a portfolio (see p. 37).

Guidelines

- Encourage students to dedicate a notebook to serve as their journal.
- Prompt students to write in their journals. Devote time regularly for student journaling.
- Consistently monitor student journaling. While it is not necessary to review student entries in detail, it is advisable to ensure that students periodically record their understandings, reflections, or opinions.
- Allow students to be open in their documentations. Some students only write what they think teachers want to see. Students should be told that information in the journal/log is for learning and not necessarily scoring.
- Inform students that their entries will be confidential and available to the teacher and student or student only.

Advantages

- Allows teachers to see understandings and misunderstandings of students in the learning process.
- Provides a record of daily activity or work accomplished.
- Allows students to reflect on their own past learning experiences.
- Documents accounts of individual student learning. Provides students a means for self reflection.

Limitations

- Students may write what they think teachers are looking for. This distorts what teachers think students are "getting" or "not getting."
- Students may tend to get off track and not fully explain their understandings, questions, or opinions.

Modeling / Prototyping

Description. Modeling is the process by which students develop a detailed, small-scale visual, mathematical, or three-dimensional representation of an object or design (model). Prototyping is the process by which students develop a full-scale working model of the final solution (prototype) (ITEA, 2000/2002). Modeling and prototyping are processes that require students to demonstrate their knowledge and abilities to meet specified criteria and/or constraints. Teachers gauge student understanding by considering student abilities to satisfy pre-determined parameters.

Guidelines

- Select content to ensure that students demonstrate knowledge of technological concepts and not simply create a model or prototype for the sake of doing.
- Select content that is relevant to students and their experiences outside of the classroom.
- Consider the process in which students will engage.
- Provide students with clear expectations so they will know what will be assessed: function, aesthetics, process, construction techniques, safety considerations, etc.
- Provide students with opportunities to work together collectively rather than individually.

Advantages

- Allows students to demonstrate understanding by applying their knowledge and abilities.
- Students are able to learn about technology by "doing" technology.
- Provides practical opportunities to connect to the real world.

Limitations

- Requires a substantial amount of time in comparison to some other tools and methods, both in the creation of the model or prototype and the critique of it.
- Critiquing the model or prototype involves subjectivity.

Multiple-Choice Test

Description. A multiple-choice test poses a series of questions to students and requires that they select the correct answer, or the "best" answer, from a series of choices. Multiple-choice tests are among the more commonly used paper-and-pencil tests.

Guidelines

- Begin with a question that you want answered. State it as a direct question, or make it an incomplete statement.
- State the problem in the stem. The stem should provide as much needed content as possible so students do not have to "work" at making sense of the test item. The stem should make sense all by itself.
- Provide three to five "alternatives" or possible responses, each having some merit, with only one being the correct answer.
- Include the correct alternative as well as incorrect alternatives, or distracters, as possible answer options.
- Use distracters that make the student think about each choice carefully. Answer choices should be comparable—avoid giving cues by making the length of the answers similar and maintaining consistency in the complexity of responses. Eliminate the use of "all of the above" or "none of the above."
- CAPITALIZE, **bold face**, and/or <u>underline</u> negative wording, including instances in which the answer is an exception.
- Use grammatically correct stems and choices, specifically when the choices need an "a" or "an."
- Place correct answers in random order throughout the test.
- Avoid giving away answers to questions or statements in other test items.

Advantages

- Less costly than other forms of testing.
- Easy to administer to a large number of students.
- Can sample a wide variety of learning targets.
- "Fast" tool to test student knowledge of specific content.
- Can be used diagnostically to improve instruction.

Limitations

- Can fail to assess higher-order thinking skills.
- Provides just one measure of student learning.
- Are constructed upon the assumption that knowledge can be represented by an accumulation of bits of information and that there is only one "right" answer.
- Encourages teaching to the test, which narrows the curriculum.

(Adapted from Georgia Department of Education, 2000; Popham, 1999)

Observation

Description. Observation refers to the act of absorbing information by seeing and/or listening to students. Teachers witness student understanding by watching and/or listening to students as they demonstrate their knowledge and abilities. Teachers may observe students as they attempt to solve a design problem, or observe students as they discuss an issue such as global warming.

Guidelines

- Specify focus for observations. Determine what you are "looking" for.
- Record observations in writing. Figure 8 illustrates a sample observation form that could be used when observing students.
- Note the typical as well as the atypical. Observations of the routine are just as valuable as observations of the extraordinary.
- Repeat observations. One instance does not make a pattern.
- Synthesize evidence from different contexts to increase the validity of observations.
- Observe all students, often and regularly.

Advantages

- Provides opportunity to assess students while they are engaged in an activity.
- Judgments of student learning can be made initially, in-progress, rather than after-the-fact.
- Recorded evidence can later be evaluated for accuracy. Decisions regarding instructional adjustments can be made.

Limitations

- Requires substantial amount of time in comparison to some other tools or methods.
- Tendency to watch for "bad" behaviors. Attention may focus on what students are doing wrong rather than on what they are doing correctly.

(Adapted from Hart, 1994)

Figure 8. Sample Observation Form

Observed Behaviors	What was Observed	Notes, Comments
Student groups are on task.		
Students are actively discussing the issue.		
Students are using prior concepts to solve the problem.		
Students are exhibiting a positive attitude.		
Students are demonstrating an understanding of ... [technological problem solving].		
Students are using multiple strategies to address the problem.		
Students are using a variety of skills to present a group solution.		
Others		

(Enger & Yager, 2001, p. 98)

SECTION 3

Open-Ended Questioning

Description. "An open-ended question is a question that does not have just a single right answer but can be answered in a number of ways" (Carin & Bass, 2001, p. 144). Teachers present a question, situation, or scenario, and students respond, verbally, in writing, or by creating something. Open-ended questioning may be used to generate a discussion (see p. 31). Teachers assess higher-order thinking skills and are able to "get at" understandings that are otherwise difficult to measure. Freedman (1994) suggests asking questions that engage students in:

1. Analysis: Students are challenged to analyze a situation and to suggest possible solutions, requiring that they think critically about the situation, gather information pertaining to the situation, and write, illustrate, model, or communicate possible solutions.
2. Comparison: Students are challenged to examine a situation and compare selected elements of the situation, requiring that they critically examine the strengths and weaknesses and/or pros and cons of the situation.
3. Description: Students are required to respond to the situation by offering a description. The description provides detail of the situation and might be of such things as an event or a process.
4. Evaluation: Students are challenged to gather information, analyze it, and make judgments.
5. Fiction: Students write stories based on information, patterns, and trends from data gathered and analyzed that may not be based upon present-day realities.
6. Problem solving: Students respond to a question by detailing the process in which they are engaged. Students may detail the gathering, analysis, and interpretation of data to identify resulting trends and forecast possible outcomes.

Guidelines

- Identify probing questions in advance to ensure that the conversation does not stray from the subject matter.
- Be specific in the questions that are asked. Do not accept absolute responses such as "yes" or "no," or generalities such as, "it was too hard" or "it was fun." Require students to offer explanations that validate their opinions.
- Engage students in discussion regularly, throughout an activity, lesson, unit, etc.
- Record feedback.
- Utilize feedback to determine modifications needed to the current lesson as well as the focus for future lessons.

Advantages

- Students are challenged to consider content and/or ideas from different perspectives.
- Students can learn from each other.
- Students learn on their own by vocalizing their understandings and justifying their arguments.
- Provides an opportunity for students to engage in in-depth thinking about the content.

Limitations

- Requires some time to develop probing questions.
- Discussions easily stray from the subject matter.

Portfolio

Description. A portfolio is a 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. Portfolios take various forms, from photographs depicting student growth and understanding to specialized electronic journals showing work completed over a period of time (ITEA, 2003). A review of work presented in a portfolio provides an impression of how well a student is doing. (Appendix K contains an example of a scoring rubric for use with a portfolio.)

Guidelines

- Determine the kind of evidence students should include in their portfolios—for example, tell students whether they are showcasing their understanding or documenting their progress.
- Clearly identify and communicate the focus of the portfolio. Students must be able to determine the type of evidence to include in their portfolios (for example, objects, drawings, plans, written statements, and photos).
- Insist that students organize their portfolios. This enables efficient review of the portfolios.

Advantages

- Provides a means for collecting a variety of evidence of student learning.
- Allows students to make decisions about selecting representations of their "best" work.
- Allows students to demonstrate their progress toward technological literacy rather than requiring an absolute level of performance at a given instance.
- Provides an opportunity to link the evidence collected directly to instruction.
- Provides an opportunity for students to connect what they are doing in school with their interests outside of school.
- Provides opportunities for teachers to review student portfolios as a means of reflecting on the effectiveness of their teaching.
- Provides a holistic picture of student learning.

Limitations

- Requires a substantial amount of time in comparison to some other tools and methods.
- Critiquing the portfolio involves subjectivity.

(Adapted from Barton & Collins, 1997)

SECTION 3

Project

Description. A project involves students in practical contexts reflective of real world experiences, requiring that they demonstrate their understanding by proposing solutions to issues of relevance and value to others. "Open-ended in nature, a project poses multiple solutions and engages students in a 'whole' situation, one that encourages discovery of its parts, relationships, meaning, and resolution" (Campbell, Campbell, & Dickinson, 1996, p. 253).

Guidelines

- Identify important concepts or practices and determine an open-ended project that encompasses such knowledge. Identify practical and relevant concepts with which students have some connection and about which they can be excited.
- Involve students in planning the various aspects of a project. At times, students should also determine their own projects.
- Guide students through various stages of project initiation, implementation, refinement, presentation, reflection, assessment, and revision.
- Select student drafts and final work to submit for documentation during and upon completion of the project.
- Ask students to think back over their learning processes and personal growth achieved as a result of the project.
- Have students present their projects to an audience of classmates, parents, community members, or others who will support as well as offer constructive criticism of student efforts.
- Assess the project from numerous perspectives.
- When students have completed their projects, reflect on what their work reveals about them—interests, strengths, challenges, whether they are independent or collaborative workers, and what interests emerged that might be addressed in future projects.

Advantages

- Provides opportunities for students to transfer classroom learning to practical contexts.
- Provides opportunities for interdisciplinary learning enabling students to see the relationships among technologies and the connections between technology and other fields of study.

Limitation

- Requires substantial amount of time in comparison to some other tools and methods.

(Adapted from Campbell et al., 1996)

Self Assessment / Peer Assessment

Description. Self assessment encourages students to reflect upon and evaluate their own learning. Student reflection should occur periodically so students can keep informed of their own progress toward technological literacy. Peer assessment encourages students to provide feedback to one another related to the learning that has occurred. Students may be asked to peer assess a partner, a group of students, or the entire class.

Guidelines

- Provide students with a clear understanding of what is expected of them and what is to be learned.
- Consider allowing students to help define parameters for their assessment. This will allow them to understand the learning goal and thus be able to self/peer assess on a more "grounded" level.
- Allow students to self correct.

Advantages

- Students gain a better understanding and appreciation for the assessment process by participating in it.
- Students are able to ascertain what knowledge and abilities they have gained during the learning process.
- Students can learn from their own mistakes.

Limitations

- If students do not have a clear understanding of what is expected of them, then the self/peer assessment will not be successful.
- Students may not take the self-assessment or peer-assessment process seriously. Giving oneself or one's friend an "A" for the sheer purpose of giving it can be a downfall if the purpose of the self/peer assessment is focused on scoring purposes alone.

True-False Tests

Description. True-false test items require that students respond to statements by selecting one of only two potential answer options—"true" or "false."

Guidelines

- Eliminate extraneous wording and use of distracters.
- Use uncomplicated vocabulary and concise sentence form. Simple is better!
- Avoid use of negative statements. The use of negative statements should only be considered when they are the best way to elicit the correct answer. Emphasize negative words using ALL CAPITAL LETTERS, **bold font**, and/or <u>underlining</u>.
- Give specific statements of opinion with the source.
- Prepare an equivalent number of true statements as false statements.

Advantages

- Relatively easy to construct.
- Requires only a short time to administer.

Limitation

- Students have a 50-50 chance of selecting correct answers and can answer correctly even if they do not know the information.

(Adapted from Georgia Department of Education, 2000)

Photo courtesy of James Kirkwood

SECTION 3

Scoring Devices

Scoring, grading, measuring, judging, or assigning value—whether we are using a multiple-choice test or a design brief, at some point we need to consider individual student achievement. Many of the assessment tools and methods described in this section provide subjective evidence of student learning rather than objective evidence. In such instances, we must use scoring devices to help us make more objective decisions based on specific criteria. Checklists and rubrics are two scoring devices that we might consider.

Checklist

A checklist is an evaluative device, generally in the form of a simple listing of criteria that define expectations for student responses. Please see Figure 8 on page 35.

Rubric

A scoring rubric is essentially a two-dimensional matrix that provides criteria against which to assess student performance. One axis of the matrix presents a set of concepts, elements, traits, or big ideas, while the other axis defines levels of achievement. The two axes, one vertical and the other horizontal, form rows and columns. Figure 9 provides a template that teachers might find helpful to use when developing a scoring rubric. Appendix K contains some examples of completed scoring rubrics.

Scoring rubrics help the teacher by:

- **Enabling the teacher to more objectively critique evidence of student learning.** The gathered evidence determines how well students really understand the content.
- **Generating feedback for improved instruction.** Knowing how well students truly understand important concepts helps the teacher modify instruction to improve learning.
- **Monitoring student progress.** Teachers can make students aware of their strengths and areas where improvement is necessary.
- **Grading student performance.** Sound grading is based on sound assessment tools and methods. Sound assessment practices are based on clear targets.

Scoring rubrics help the student by:

- **Identifying what is expected.** Students are aware of what they are supposed to know and how well they should know it.
- **Generating feedback for improved learning.** Students can improve their learning by knowing where they need to improve and how they can improve their performance.
- **Establishing criteria for grading that are based on clear expectations and objective evidence.** Student scoring is consistent with the expectations about which they were informed. Students are aware of what is expected and know how their performance will be scored in accordance with these expectations.

Considerations for developing rubrics include:

- Rubrics should not be overly complex. That is, they should contain six or fewer big ideas for assessment and five or fewer levels of performance.
- Rubrics can be used over and over again. It is up to the discretion of the teacher to tailor the rubric to ensure content accuracy and grade level appropriateness.
- Criteria within a rubric should be consistent. For example, if most of the criteria are calling for measures of quality in a performance, stay with quality throughout the rubric. Don't suddenly switch to a quantity-measure along the way. Both quality and quantity are appropriate measures; they just need to be stated consistently in the criteria throughout the rubric.
- Students can be involved in generating rubric criteria. This can be an interesting way for them to discuss and help determine what is important for them to learn.

- Acceptable performance should first be defined, then criteria can be written for performance that exceeds or falls short. The following questions may prove helpful to teachers as they differentiate levels of performance and establish criteria defining the characteristics that represent each level of performance.
  1. What would be sufficient and revealing evidence of understanding?
  2. What performance tasks must anchor the unit and focus the instructional work?
  3. How will the teacher be able to distinguish between those students who really understand and those who do not (though they may seem to)?
  4. Against what criteria will the teacher distinguish work?
  5. What misunderstandings are likely? How are they checked for?

Figure 9. Rubric Template

(Describe the task or performance that this rubric is designed to assess here.)

	Beginning	Developing	Accomplished	Exemplary	Score
	1	2	3	4	
Stated Objective or Big Idea	Description of identifiable characteristics reflecting a beginning level of performance.	Description of identifiable characteristics reflecting development and movement toward mastery of performance.	Description of identifiable characteristics reflecting mastery of performance.	Description of identifiable characteristics reflecting the highest level of performance.	
Stated Objective or Big Idea	Description of identifiable characteristics reflecting a beginning level of performance.	Description of identifiable characteristics reflecting development and movement toward mastery of performance.	Description of identifiable characteristics reflecting mastery of performance.	Description of identifiable characteristics reflecting the highest level of performance.	
Stated Objective or Big Idea	Description of identifiable characteristics reflecting a beginning level of performance.	Description of identifiable characteristics reflecting development and movement toward mastery of performance.	Description of identifiable characteristics reflecting mastery of performance.	Description of identifiable characteristics reflecting the highest level of performance.	
Stated Objective or Big Idea	Description of identifiable characteristics reflecting a beginning level of performance.	Description of identifiable characteristics reflecting development and movement toward mastery of performance.	Description of identifiable characteristics reflecting mastery of performance.	Description of identifiable characteristics reflecting the highest level of performance.	

SECTION 4
Principles of Student Assessment

This section examines assessment principles that must be considered when designing student assessment in general and technological literacy assessment in particular.

***Assessment principles* are the basic truths, laws, or assumptions held in the use of assessment.**

Assessment principles are the basic truths, laws, or assumptions held in the use of assessment (ITEA, 2003). Effective assessment of student technological literacy:

- Utilizes fair and equitable student assessment methods.
  (AETL *Student Assessment Standard 2, Guideline C*)
- Establishes valid and reliable measurements.
  (AETL *Student Assessment Standard 2, Guideline D*)
- Reflects current research on student learning and student assessment.
  (AETL *Student Assessment Standard 3, Guideline A*)
- Incorporates both formative and summative assessment.
  (AETL *Student Assessment Standard 3, Guidelines B & C*)
- Enhances student learning.
  (AETL Student Assessment Standard 3, Guideline D)
- Allows for student commonality and diversity.
  (AETL *Student Assessment Standard 3, Guideline E*)
- Includes students in the assessment process.
  (AETL *Student Assessment Standard 3, Guideline F*)
- Reflects current technological content.
  (AETL *Student Assessment Standard 4, Guideline D*)
- Utilizes authentic assessment.
  (AETL *Student Assessment Standard 4, Guideline E*)

The assessment principles contained in this section should not be considered an afterthought of standards-based assessment. These principles must guide the development, selection, and use of tools and methods. As teachers become comfortable with the standards-based approach presented in Section 2, consideration of the assessment principles may become “rote” (second-nature) but should never be forgotten.

Utilize Fair and Equitable Student Assessment Methods

Fair student assessment is not biased or discriminatory. It provides all students with opportunities to demonstrate their understanding. Therefore, we consider all student ideas, opinions, and work with equal objectivity. Equitable student assessment requires that we use methods and procedures most appropriate to our students (Suskie, 2000). For example, we might ask our first grade students to illustrate their understandings with a drawing rather than with a three-paragraph explanation. Or, it might be appropriate for us to read an assessment tool out loud to the class if several of our students read below grade level. We recognize that even when students understand the content, they may not be able to demonstrate their understandings as well as their classmates, so we provide alternatives as appropriate.

Additionally, an assessment tool or method is considered fair and equitable when it:

- **Assesses student learning against specific criteria.** In the case of individual assessment practices, these criteria are specific to the evidence being judged.
- **Makes expectations abundantly clear to students.** It is necessary to take the time to clarify any misunderstandings students may have about our expectations.
- **Serves as ONE indicator of student technological literacy, not the ONLY indicator.** Multiple factors can influence the evidence collected by a single tool or method, so we must consider student performance on a range of assignments to ensure fairness and equitability. In other words, we assess students often, using a variety of tools and methods.
- **Improves teaching and learning.** Unless the results of assessment are compared to the teaching and learning process, neither instruction nor student understanding is likely to improve. Therefore, we use student assessment results to make sure instruction matches assessment, including teaching students how to perform the assessment. We do not use assessment results as a sorting tool to screen students either in or out of courses.

Establish Valid and Reliable Measurements

We systematically collect and record assessment data to ensure validity and reliability. Valid assessment measures have a premise from which assessment results can logically be inferred (ITEA, 2003). In other words, validity helps ensure that assessment matches the identified purpose. An assessment tool or method is considered valid when it:

- Collects evidence of student learning consistent with its identified purpose.
- Assesses the content that students have actually learned in our classrooms.

Reliable assessment measures can be repeated with consistent results (ITEA, 2003). An assessment tool or method is considered reliable when it:

- Draws assessment data from several sources.
- Is comparable to alternate test forms assessing the same content.

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

Reflect Current Research on Student Learning and Assessment

As teachers of technology, we realize that new research on teaching, learning, and assessment is being conducted every day. Therefore, we make the effort to remain aware of current research on teaching, learning, and assessment. We adjust the techniques we use to assess student learning to align with current research on how students learn technology. We consider how students learn technology and how they can demonstrate their understanding. An assessment tool or method reflects current research on student learning and assessment when it:

- Considers how students acquire new technological knowledge.
- Considers how new knowledge is connected to past understandings.
- Acknowledges how future learning can be enhanced through assessment.
- Enables us to collect data to inform instruction and enhance student learning.

***Formative assessment* is ongoing assessment in the classroom.**

Incorporate Both Formative and Summative Student Assessment

Formative assessment is ongoing assessment in the classroom. We gather formative assessment data daily "by, for example, reviewing homework, managing discussions, asking and answering questions, listening to student conversations, and observing students [at work]" (NRC, 2002, p.62). The evidence we gather through formative assessment reveals student progress toward technological literacy. Formative assessment allows us to shape our teaching *during the learning process* based on what students understand (NRC, 2002). Therefore, we must deliberately incorporate formative assessment into our teaching. This is known as "embedding" assessment. It is ongoing. Embedding makes assessment authentic and, in the end, it saves valuable time for both teacher and student. An assessment tool or method is considered formative when it:

- Occurs throughout instruction.
- Determines student misconceptions.
- Provides information on the effectiveness of instruction.
- Reveals student progress toward technological literacy.
- Facilitates instructional adjustment to enhance learning.

Summative assessment usually occurs at the end of a unit, topic, project, or problem. Summative assessment is cumulative and indicates the level of technological literacy attained. "Level" suggests a degree of understanding (e.g., a range from novice to expert). An assessment tool or method is considered summative when it:

- Occurs at a prescribed interval.
- Indicates the level of technological literacy attained by students.
- Includes learning activities that build upon previous knowledge.

Both formative and summative assessment are critical to a well-rounded student assessment approach.

Summative assessment **occurs at prescribed intervals and provides information on the level of technological literacy attainment by students.**

Enhance Student Learning

A primary purpose of student assessment is to improve teaching and learning. Teachers collect data of individual student knowledge and abilities and use that information to improve the teaching and learning process for all students. Data collection is a continuous process that enables assessment to occur as an ongoing, integral part of instruction. We provide feedback to our students and encourage our students to use assessment results to modify their own learning (ITEA, 2003).

Allow for Student Commonality and Diversity

We must strike a balance between being objective about students while recognizing and valuing their individuality. Every classroom will contain students with similar interests, cultures, abilities, socio-economic backgrounds, and special needs. Students in every classroom will also *differ* based on those same elements. If we want student similarities and differences to enhance teaching and learning, we must recognize that multiple instruments may be required to assess a single idea or concept (ITEA, 2003). At times, it will be necessary to adjust the testing environment and/or testing format to satisfy student commonality and diversity. In other instances, we might adjust the focus or level of rigor of an assessment tool or method. Such adjustments ensure that all students are provided with equitable opportunities to demonstrate their understanding. Additionally, we consider the grade level and developmental level appropriateness of assessment tools and methods.

When allowing for student commonality and diversity, assessors must be aware of specific laws that call for accommodation and/or modification to student assessment.

An assessment tool or method allows for student commonality and diversity when it:

- Supports student interests, cultures, abilities, socio-economic backgrounds, and special needs.
- Aims content at assessing student understanding with appreciation for interests, cultures, abilities, socio-economic backgrounds, and special needs.
- Provides all students with equal opportunities to successfully demonstrate understanding regardless of interests, cultures, abilities, socio-economic backgrounds, and special needs.
- Implements a variety of assessment strategies (cognitive, psychomotor, affective) that address student interests, cultures, abilities, socio-economic backgrounds, and special needs while supporting student attainment of technological literacy.

Include Students in the Assessment Process

Few would argue against the need for students to be informed of the purpose of student assessment or of the expectations for their learning. It is not reasonable for us to expect our students to demonstrate something we have not asked them to demonstrate. We can go a step further by allowing our students to help us define the purpose and expectations of assessment. Students can assist us in identifying the content to be learned and appropriate assessment tools or methods for gathering assessment data. Although teachers play a significant role in directing such a discussion, students learn more about the assessment process when they become directly involved in it.

Self-assessment activities also get students involved in the assessment process. Students reflect on past understandings, current understandings, and desired future understandings. We can require students to consider how their knowledge and abilities have developed and how they will try to advance their own knowledge and abilities in the future.

An assessment tool or method includes students in the assessment process when it:

- Provides students with the opportunity to select specific content. (*What do we need to know and be able to do in order to understand the important ideas?*)
- Enables students to select the assessment tools or methods to be implemented. *(What kind of evidence will show that we really "get it," that we understand the content? How can we demonstrate that we understand the important ideas?)*
- Allows students to define the expectations of student learning. *(How are we going to be measured to see if we are learning the "right stuff?")*

Reflect Current Technological Content

As educators, we understand that technology is dynamic—it changes with the changing needs and wants of humans. Therefore, we design student assessment tools and methods to be flexible and easy to modify. As advances in technology occur, we change our assessment tools and methods to reflect technological advancements.

***AETL* Student Assessment Standard 4, Guideline D suggests that teachers must consistently accommodate for modification to student assessment. The meanings of the terms *accommodate* and *modification* in this guideline are not consistent with the meanings of these terms as traditionally used in education. The term accommodate is NOT used to imply adaptations in the testing environment and/or testing format. Accommodate in this guideline refers to the idea that changes will need to be made in the future. The term modification is NOT used to imply that adjustments are being made to the focus or level of rigor of assessment content. Modification in this guideline refers to the revision of content to ensure assessment tools and methods reflect current technologies.**

***Authentic assessment* "…examines student performance on tasks that are directly related to what is considered worthy and necessary for developing technological literacy." (ITEA, 2003, p. 136)**

Utilize Authentic Assessment

Authentic assessment provides students with the opportunity to demonstrate their knowledge and abilities in real-world situations. An assessment tool or method is considered authentic when it:

- Determines the level at which students understand content.
- Places students in practical situations representative of the world outside of the classroom.
- Incorporates cognitive, psychomotor, and affective learning elements.
- Considers student commonality and diversity, recognizing student interests, cultures, abilities, socio-economic backgrounds, and special needs. Students understand both the test items (or expectations) and how they are expected to demonstrate their understanding of the content.
- Makes clear to the students what is expected, how their learning will be judged, and how they will receive feedback.

Grant Wiggins (1998) notes that for authenticity, assignments should be realistic, require judgment and innovation, have students actually "do" the subject, align with the process in the real world, possess complexity, and provide opportunities for performance refinement.

SECTION 5
Applying Assessment Data and Evaluating Assessment

This section presents some uses for assessment data as well as evaluative strategies for ensuring effective student assessment.

We must consistently maintain data collection for accountability (AETL *Student Assessment Standard 5, Guideline A*). As we are required to use a variety of assessment tools and methods, we will have to gather a variety of evidence. We need to develop an organized way of managing a great deal of information. Individual educators will organize data differently according to personal styles. Whatever method teachers use to file or record assessment data, they need ready access to the information to communicate results, as appropriate, to students, parents, administrators, communities, policymakers, business and industry, and the general public. Teachers should be sure their system of data management is safe and secure. This will ensure that the rights of all students are respected and that assessment results are reported with confidentiality, privacy, and security.

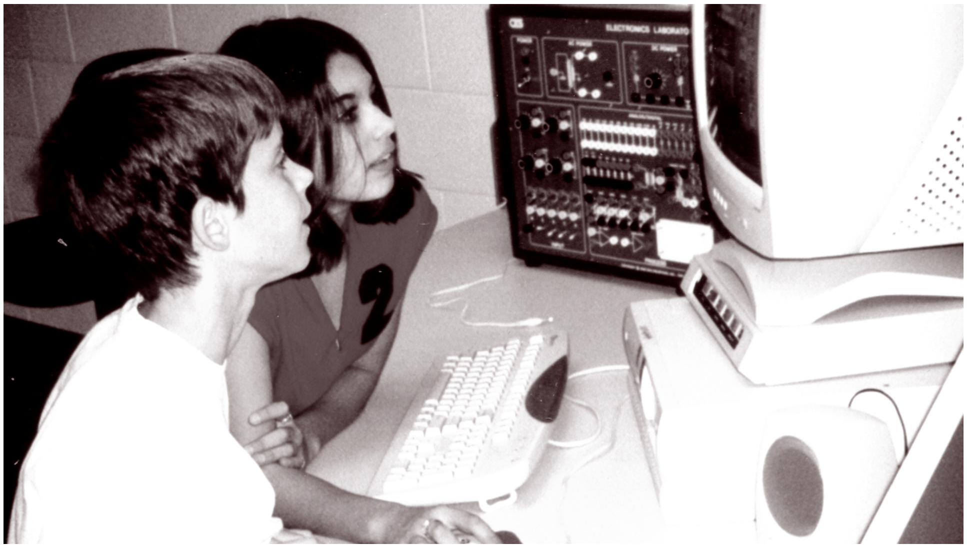
Making Use of Assessment Results

Assessment data provide information that enables teachers and others to make decisions (see Table 3 on p. 26). All educators must pay particular attention to the original purpose(s) and intended audience(s) of the assessment tool or method to ensure that results are not interpreted out of context (ITEA, 2003). Teachers use assessment data to make a variety of decisions, including:

- **Improving teaching and learning.** Teachers use student assessment results to enhance teaching and learning. Teachers verify that student assessment is ongoing and embedded within instruction. Teachers review evidence of learning throughout instruction, and instructional adjustments occur as appropriate to help all students attain technological literacy. Just as we reflect upon student assessment results to adjust instruction, students should reflect upon assessment results to modify their own learning (ITEA, 2003).

- **Assigning grades.** Although the primary purpose of assessment is to improve teaching and learning, the reality is that end-of-term grades need to be generated. However, continuous assessment will contribute significantly to the grading process by providing multiple measures from which evidence of student learning may be judged.

- **Monitoring progress.** Based on student assessment results, we can determine whether or not students have attained a level of technological literacy consistent with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002). Such data provide information regarding student progress toward technological literacy. We can determine what progress has been made as well as what progress still needs to be made.



• **Identifying levels of technological literacy.** Student assessment results assist teachers in determining the level of technological literacy attained by students. We consider the content standards and benchmarks in *STL* to gauge whether or not our students are performing at the desired level consistent with the appropriate grade band.

• **Determining instructional effectiveness.** Teachers continually refine their teaching practice based on student assessment results. We determine the reasons for the assessment results and use that information to adjust instruction as appropriate. For example, unexpected results may indicate student misunderstanding or some external factor. Teachers adjust instruction to present content in an alternative manner and attempt to clarify misunderstanding. Data collected in the classroom assist teachers as we modify instruction to meet the needs of our students based on the evidence of student learning gathered by student assessment.

• **Communicating results.** We should provide students with the necessary feedback for adjusting their own learning. Parents should be provided the necessary feedback for monitoring their child's progress and making decisions about the quality of the technology program. Teachers determine which results to provide to administrators, communities, policymakers, business and industry, and the general public to inform them of student technological literacy.

• **Marketing and promotion.** Teachers should use standards-based student assessment results to solicit support from stakeholders for the technology program by communicating the characteristics of technological literacy, its importance, and the need for all students to attain it.

- **Guiding professional development decisions.** Student assessment results can help guide professional development decisions for teachers (AETL *Student Assessment Standard 5, Guideline B*). Teachers assume the responsibility for their own continuous professional growth and seek in-service activities that help us maintain and enhance our professional and technological abilities. We base our professional development decisions on the learning needs of our students. Some activities in which teachers might participate include:

    1. Membership in local, state, and national professional organizations.
    2. Collaboration with other professionals in the fields of education, technology, and engineering.
    3. Involvement in mentoring activities with other technology teachers and other content area teachers.
    4. Engagement in informal education programs provided by businesses, industries, and museums, among others.

- **Guiding program enhancement decisions.** We also use student assessment results to help guide program enhancement decisions (AETL *Student Assessment Standard 5, Guideline C*). Teachers review student assessment results to remain informed about the status of the technology program. Teachers ensure that the purpose for collecting data was for program evaluation. Teachers and others examine results with attention to the purpose and intended audience to ensure that results are not interpreted out of context. Student assessment results are considered in conjunction with other program elements to determine overall program effectiveness. The bottom line is, *are students attaining technological literacy*? Areas of concern are identified based on assessment results and may include such things as staffing, curricula, instruction, materials, facilities, or equipment. We analyze student assessment results for clues and ideas regarding how the data can be used in program enhancement. Program enhancement decisions are made based on student assessment results and the need for ensuring high quality programs.

Evaluating Student Assessment

As with any process, we must evaluate the quality of student assessment. Appendix J is a form for teachers to use in evaluating student assessment. Evaluation ensures that every opportunity to link student assessment with technological literacy standards is considered. As we reflect upon the results of student assessment, we must remember that we want all students to attain technological literacy. Judy Carr and Douglas Harris (2001, p. 59) suggest three questions as the basis for leadership decisions in a standards-based system that ITEA staff adapted and expanded for use in evaluating student assessment: 1) *What are the student results*? 2) *Why are they what they are*? 3) *What were our expectations for teaching and learning*? 4) *How do the student results compare with our expectations*? and 5) *What strategies can be implemented to ensure consistency between what is expected and what results*?

The results from the evaluation of student assessment can be used to either validate how well the current assessment process is actually working or to identify areas where improvement is desirable. As is the case in many evaluations, it is the parts of the system that generally need improvement or refinement, not the entire process.

A Journey, Not a Destination

> At the heart of our modern technological society lies an unacknowledged paradox. Although the United States is increasingly defined by and dependent on technology and is adopting new technologies at a breathtaking pace, its citizens are not equipped to make well-considered decisions or to think critically about technology. As a society, we are not even fully aware of or conversant with the technologies we use every day. In short, we are not "technologically literate" (NAE & NRC, 2002, p. 1).

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

Achieving technological literacy will be the result of a combined approach through professional development, curricula, instruction, student assessment, and the learning environment, coordinated to deliver the content of *STL* in a manner consistent with the standards in *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (*AETL)*(ITEA, 2003). Realizing the vision of *STL* and *AETL*, that all students can and deserve to become technologically literate through appropriate K–12 education, will require support from educators, parents, and communities committed to developing a technologically literate citizenry. Effective student assessment enables us to document student progress toward technological literacy. Knowing where students are and where they should be—through a standards-based student assessment approach—enables us to develop strategies to advance student technological literacy. Technology is continually evolving and therefore, the standards reflecting technology must evolve as well. Technological literacy then, becomes a journey and not a destination. It is a journey to which we must all commit, if we are to attain a technologically literate populace.

APPENDICES

- A Acknowledgements
- B Listing of *STL* Content Standards
- C Listing of *AETL* Student Assessment Standards with Guidelines
- D Listing of *AETL* Professional Development Standards
- E Listing of *AETL* Program Standards
- F Fundamental Questions of Standards-Based Planning
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- I Unit Level Standards-Based Student Assessment Form
- J Evaluating Student Assessment: *Have We Arrived?*
- K Scoring Rubric Examples
- L References and Resources
- M Glossary

APPENDIX A
Acknowledgements

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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.

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 with Guidelines

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

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

A. Administer comprehensive planning and development across disciplines.
B. Incorporate comprehensive planning and development across grade levels.
C. Include cognitive learning elements for solving technological problems.
D. Include psychomotor learning elements for applying technology.
E. Guide student abilities to operate within the affective domain, utilizing perspective, empathy, and self-assessment.

Standard A-2: Assessment of student learning will be explicitly matched to the intended purpose.
Guidelines for meeting Standard A-2 require that teachers consistently

A. Formulate a statement of purpose for assessment tools.
B. Identify and consider the intended audience in designing assessment tools and reporting assessment data.
C. Utilize fair and equitable student assessment methods.
D. Establish valid and reliable measurements that are reflective of classroom experiences.

Standard A-3: Assessment of student learning will be systematic and derived from research-based assessment principles.
Guidelines for meeting Standard A-3 require that teachers consistently

A. Remain current with research on student learning and assessment.
B. Devise a formative assessment plan.
C. Establish a summative assessment plan.
D. Facilitate enhancement of student learning.
E. Accommodate for student commonality and diversity.
F. Include students in the assessment process.

Standard A-4: Assessment of student learning will reflect practical contexts consistent with the nature of technology.
Guidelines for meeting Standard A-4 require that teachers consistently

A. Incorporate technological problem solving.
B. Include variety in technological content and performance-based methods.
C. Facilitate critical thinking and decision making.
D. Accommodate for modification to student assessment.
E. Utilize authentic assessment.

Standard A-5: Assessment of student learning will incorporate data collection for accountability, professional development, and program enhancement.
Guidelines for meeting Standard A-5 require that teachers consistently

A. Maintain data collection for accountability.
B. Use student assessment results to help guide professional development decisions.
C. Use student assessment results to help guide program enhancement decisions.

APPENDIX D
Listing of *AETL* Professional Development 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 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

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

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

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

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

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

Fundamental Questions of Standards-Based Planning

Fundamental Questions of Standards-Based Planning

As teachers, administrators, and policymakers plan standards-based student assessment, they may find it useful to consider the suggestions below.

Questions	Classroom Level Suggestions	School Level Suggestions	School District Level Suggestions
Where are we now?	• Identify the current level of student technological literacy. • Evaluate course(s) to determine the status of technology content, professional development, curricula, instruction, **student assessment,** and the learning environment.	• Consider the current level of student technological literacy. • Evaluate and compare programs to determine the status of technology content, professional development, curricula, instruction, **student assessment**, and learning environments in technology laboratory-classrooms and other content area classrooms.	• Evaluate and compare school programs for the study of technology to determine the status of content, professional development, curricula, instruction, **student assessment**, and learning environments across schools within the district.
Where do we want to go?	• Consider national/federal technological literacy standards (*STL* and *AETL*). • Consider state/provincial/regional technological literacy standards. • Consider school district standards.	• Consider national/federal technological literacy standards • Consider state/provincial/regional technological literacy standards. • Consider school district standards.	• Consider national/federal technological literacy standards (*STL* and *AETL*). • Consider state/provincial/regional technological literacy standards.
How are we going to get there?	• Identify *STL* standards to serve as the basis for content of student assessment. • Consider *AETL* standards and guidelines. • Collect and use evidence of student learning to inform and enhance teaching and learning.	• Advocate technology content that complements school district, state/provincial/regional, and national/federal standards. • Use student assessment results to help guide professional development and program enhancement decisions.	• Establish articulated and integrated technology programs districtwide. • Employ licensed teachers to deliver technology content. • Mandate instruction in the study of technology for all students across grade levels and disciplines.
What knowledge and abilities must educators possess to get there?	• Identify professional development requirements based on your needs that align with *STL* and *AETL*. • Select opportunities that enable you to remain current with research on student learning and assessment. • Ensure responsibility for your own continued professional growth.	• Support teacher personal professional growth. • Provide in-service activities to enhance teacher understanding of technological content, instruction, and assessment. • Evaluate professional development activities to assure that the needs of teachers are being met.	• Support sustained professional development of all educators. • Establish a professional development program based on *STL* and *AETL* to provide coordinated in-service activities. • Evaluate the professional development program to assure that the program is comprehensive and continuous.
How will we know when we have arrived?	• Consider student learning in relation to *STL*. • Consider whether student assessment practices align with *AETL*. • Consider the effectiveness of student assessment. • Assure that evaluation is systematic and continuous.	• Assure that evaluation is systematic and continuous. • Assure that evaluation is consistent with the program standards in *AETL*.	• Assure that evaluation is systematic and continuous. • Assure that evaluation is consistent with the program standards in *AETL*.

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 Level 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 Level Classrooms						Technology Laboratory-Classrooms						
	K	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

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.														

APPENDIX H

Course Level

Standards-Based Student Assessment Form

Step 1. SELECT CONTENT STANDARDS, THEN IDENTIFY BENCHMARKS
Identify and document the content standards that will serve as the basis for student assessment. Then select the benchmarks that add detail to the concepts that will be taught and assessed. Multiple copies of this page may be needed.

> **STOP! And confirm:** Review the selected content standards and benchmarks to verify that they *include variety in technological content.*

Step 2. EXTRACT AND ORGANIZE CONTENT
What are the specific understandings students should possess having engaged in the content of the standards and benchmarks? What are the big ideas students should learn to ultimately understand the standards and benchmarks?

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Step 3: DEFINE ASSESSMENT CRITERIA
What are the expectations for student learning? Define criteria at levels which meet, exceed, and fall below your expectations.

NOTE: Defining assessment criteria at various levels requires that you first determine the number of levels that will be assigned. You may choose to use any of the three tables that follow or develop one of your own.

Big Ideas	Assessment Criteria		
	Below Target	**At Target**	**Above Target**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:
- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Big Ideas	Assessment Criteria				
	No Response	**Inadequate Response**	**Minimal Response**	**Competent Response**	**Exemplary Response**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:

- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Big Ideas	Assessment Criteria			
	Novice	**Apprentice**	**Journeyman**	**Expert**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:

- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Step 4: SELECT AND USE ASSESSMENT TOOLS AND/OR METHODS

Identify and record the tools and methods that will be used to assess students for this course. The tools and methods you select will depend upon how you structure assessment for the course. For example, you may or may not choose to develop a summative course level assessment instrument. You might choose to incorporate unit level assessment tools and methods, or you might choose to look at unit level assessment results holistically. In any case, the tools and/or methods you choose should incorporate student work over time and include variety in both content and method.

STOP! And confirm: Review the assessment tools and methods listed above. Verify that they *include variety in performance-based methods*.

Step 5: MAKE USE OF ASSESSMENT RESULTS

Compare the assessment results with your expectations for student learning. Consider strategies to improve teaching and learning so that results will match expectations.

Consider other positive ways to use the assessment results from your course.

Unit Level
Standards-Based Student Assessment Form

Step 1: SELECT CONTENT STANDARDS, THEN IDENTIFY BENCHMARKS
Identify and document the content standards that will serve as the basis for student assessment **by re-examining Steps 1 and 2 at the course level.** Then select the benchmarks that add detail to the concepts that will be taught and assessed.

> **STOP! And confirm:** Review the selected content standards and benchmarks to verify that they *include variety in technological content.*

Step 2. EXTRACT AND ORGANIZE CONTENT
What are the specific understandings students should possess having engaged in the content of the standards and benchmarks? What are the big ideas students should learn to ultimately understand the standards and benchmarks?

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Content Standard	Benchmark		
	Big Idea:	Big Idea:	Big Idea:

Step 3: DEFINE ASSESSMENT CRITERIA

What are the expectations for student learning? Define criteria at levels which meet, exceed, and fall below your expectations.

NOTE: Defining assessment criteria at various levels requires that you first determine the number of levels that will be assigned. You may choose to use any of the three tables that follow or develop one of your own.

Big Ideas	Assessment Criteria		
	Below Target	**At Target**	**Above Target**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:
- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Big Ideas	Assessment Criteria				
	No Response	**Inadequate Response**	**Minimal Response**	**Competent Response**	**Exemplary Response**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:

- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Big Ideas	Assessment Criteria			
	Novice	**Apprentice**	**Journeyman**	**Expert**

STOP! And confirm: Review the assessment criteria defined above. Verify that they:

- *Include cognitive learning elements for solving technological problems.*
- *Include psychomotor learning elements for applying technology.*
- *Include affective learning elements suitable for utilizing perspective, empathy, and self assessment.*
- *Incorporate technological problem solving.*
- *Facilitate critical thinking and decision making.*

Step 4: SELECT AND USE ASSESSMENT TOOLS AND/OR METHODS

Identify and record the tools and methods that will be used to assess students on this unit. Selection of tools and methods should be based on the content being assessed, the type of evidence being gathered, and the audience for assessment results.

Assessment Tool/Method	Content	Evidence	Audience

NOTE: Students should be assessed often, using a variety of tools and methods. **STOP! And confirm:** Review the assessment tools and methods listed above. Verify that they *include variety in performance-based methods*.

Step 5: MAKE USE OF ASSESSMENT RESULTS

Compare the assessment results with your expectations for student learning. Consider strategies to improve teaching and learning so that results will match expectations.

Consider other positive ways to use the assessment results from your unit.

APPENDIX J
Evaluating Student Assessment: *Have We Arrived?*

Considerations for Assessment of Student Technological Literacy	Yes	No	Not Applicable (N/A)	Comments
Student assessment adheres to accepted principles.				
• Student assessment is fair and equitable.	Yes	No	N/A	
• Student assessment measures are valid and reliable.	Yes	No	N/A	
• Student assessment reflects current research on student learning and student assessment.	Yes	No	N/A	
• Student assessment incorporates both formative and summative assessment.	Yes	No	N/A	
• Student assessment considers student commonality and diversity.	Yes	No	N/A	
• Students are included in the assessment process.	Yes	No	N/A	
• Student assessment reflects current technological content.	Yes	No	N/A	
• Authentic assessment is used.	Yes	No	N/A	
Student assessment is administered across grade levels.	Yes	No	N/A	
Student assessment is administered across disciplines.	Yes	No	N/A	
Student assessment advances student technological literacy.				
• Students develop an understanding of the nature of technology.	Yes	No	N/A	
• Students develop an understanding of technology and society.	Yes	No	N/A	
• Students develop an understanding of design.	Yes	No	N/A	
• Students develop abilities for a technological world.	Yes	No	N/A	
• Students develop an understanding of and are able to select and use technologies of the designed world.	Yes	No	N/A	
Assessment tools/methods clearly define the purpose for student assessment.	Yes	No	N/A	
Assessment tools/methods identify the audience(s) to whom assessment results will be provided.	Yes	No	N/A	
Assessment tools/methods are flexible to allow for revisions based upon the changing nature of technology.	Yes	No	N/A	

Assessment tools/methods are appropriate for gathering evidence of student technological literacy learning. • Evidence is gathered to indicate that students understand the content in *Standards for Technological Literacy*. • 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.	Yes Yes Yes Yes Yes Yes	No No No No No No	N/A N/A N/A N/A N/A N/A	
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 decisions. • Data are used to guide program enhancement decisions.	Yes Yes Yes Yes Yes Yes Yes	No No No No No No No	N/A N/A N/A N/A N/A N/A N/A	
Student assessment is evaluated for quality.	Yes	No	N/A	

APPENDIX K
Scoring Rubric Examples

Example Portfolio Scoring Rubric				
Scale / **Expectation**	**1** **Beginning to Attain Expectations**	**2** **Nearly Attained Expectations**	**3** **Achieved Expectations**	**4** **Exceeded Expectations**
Portfolio is aesthetically pleasing.	Portfolio has few unintended mistakes in the way it is decorated and appears.	Portfolio has extra graphic and text elements that accent contents, providing an interesting look.	Portfolio has extra graphic and text elements that accent contents, provide an interesting look, and establish a format that carries over from one unit to the next.	Portfolio has format elements that improve the look and interest of the portfolio, are drawn well, maintain the overall format, and are free of mistakes.
Portfolio is effectively organized.	Portfolio has broad categories that help the student to group design processes.	Portfolio has subheadings that further organize the design process.	Portfolio is organized in a way appropriate for the content being studied and has an appropriate amount of narrative explanation.	Portfolio is organized by a design process sequence, has appropriate narrative explanation, and is appropriate for the content being studied.
Portfolio includes thumbnail sketches of various design solutions to the problem.	Thumbnail or rough sketches are evident.	Portfolio includes thumbnail sketches of various design solutions to the problem at hand.	Portfolio includes thumbnail sketches of various design solutions, and at least one is related to the final solution.	Portfolio includes thumbnail sketches of various design solutions, and they illustrate a progression of idea development.
Portfolio includes technical sketches.	Technical sketches are evident.	Technical sketches are related to subsequent technical drawings.	All of those technical sketches necessary to communicate the solution idea are included and are scaled and proportional.	Portfolio has a comprehensive set of sketches, and each sketch is complete and follows conventions appropriate to the content area.
Portfolio includes orthographic drawings or those appropriate to the content.	Orthographic drawings are evident.	Orthographic drawings are related to subsequent pictorials and renderings.	All of the orthographic drawings necessary to communicate the solution idea are included and are scaled and proportional.	Portfolio has a complete set of orthographic drawings, and each drawing is complete and follows conventions appropriate to the content area.
Portfolio includes pictorial drawings or those appropriate to the content.	Pictorial drawings are evident.	Pictorial drawings are based upon orthographic drawings and related to subsequent renderings.	All of the pictorial drawings necessary to communicate the solution idea are included and are scaled and proportional.	Portfolio has a complete set of pictorial drawings and each drawing is complete and follows conventions appropriate to the content area.
Portfolio includes a rendering of the solution.	Rendering is evident.	Rendering obviously depicts the actual solution.	Rendering obviously includes consideration of shape, form, color, and texture.	Rendering demonstrates consideration of shape, form, color, and texture. Rendering looks realistic.

Example Modeling / Prototyping Scoring Rubric			
Level / **Expectation**	**1** **Below Target**	**2** **At Target**	**3** **Above Target**
Generating Ideas	Presents a few ideas, primarily as sketches.	Presents ideas with little variety, flexibility, or representation.	Represents ideas, changes with new information, and grows as new variables are introduced. Uses graphic and physical mediums.
Testing Ideas	No plan for experimentation, tests are few, results have limited possibilities.	Plan for experimentation is unclear, improvement is minimal.	Presents a plan for experimentation, represents ideas and solicits feedback, and changes as variables are introduced. Shows refinement and improvement.
Communicating Ideas	The proposed solution is relatively unclear and unappealing.	Communicates the solution adequately.	Communicates the solution clearly and creatively using an appropriate medium.

Example Design Brief Scoring Rubric			
Level / **Expectation**	**1** **Below Target**	**2** **At Target**	**3** **Above Target**
Drawing	Communicates the design but leaves much to the discretion of the user.	Communicates the design with most of the information readily available.	Communicates the design efficiently and effectively.
Modeling	Leaves in question whether the design will actually work.	Suggests that the design will probably work.	Makes it clear that the design will work.
Documenting	A sampling of materials depicts some of the work leading to the final solution.	A collection of materials represents most of the work leading to the final solution.	A well-organized portfolio contains all of the work leading to the final solution.
Presenting	The presentation does a reasonably good job of communicating the final solution.	The presentation communicates the final solution effectively.	The presentation creatively communicates the final solution efficiently and effectively.

Example Emotional Intelligence Scoring Rubric						
Expectations / **Level**	**Focus**	**Goals**	**Modifying Performance**	**Motivation**	**Optimism**	**Optimal Performance**
3 **Above Target**	Has a clear understanding of the task, stays with it, and is observant for changing conditions.	Establishes short- and long-term goals.	Seeks and applies feedback to improve performance.	Self-directed and pursues goals with enthusiasm and confidence.	Exhibits a positive attitude and influences others.	Has a sense of high quality performance, and works toward it.
2 **At Target**	Understands the task and tends to stay with it.	Establishes only short-term goals.	Accepts feedback with hesitation but does use it to improve performance.	Pursues goals with encouragement.	Usually has a positive attitude.	Has a sense of high quality performance and usually works toward it.
1 **Below Target**	Understands the task but is easily distracted.	Has difficulty setting goals.	Unwilling to use feedback to improve performance.	Pursues tasks, but only with prodding.	Tends to be pessimistic.	Has difficulty pursuing high quality performance.

APPENDIX L
References and Resources

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Glossary

The terms defined and described in this glossary apply specifically to Measuring Progress: A Guide to Assessing Students for Technological Literacy. *These terms may have different meanings in different situations.*

Accommodation — 1. Allowing for changes to be made. 2. Adjustment in the testing environment and/or testing format.

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

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.

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

Articulated — 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 — See student assessment.

Assessment criteria — The expectations of student learning that are used for collecting information on student learning. They define "what a student should look like" and can be measured and/or observed.

Assessment method — Any of the techniques used by teachers that enable students to demonstrate understanding; i.e., open-ended questioning, observation, etc.

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, ensure developmental appropriateness, and be barrier-free.

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

Authentic assessment — An assessment method that directly examines student performance on tasks that are directly related to what is considered worthy and necessary for developing technological literacy. Traditional assessment, by contrast, relies on indirect or stand-in tasks or questions that are more efficient and simplistic than they are helpful in determining what students actually know and can do.

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.

Brainstorm — A method of shared problem solving in which all members of a group spontaneously, and in an unrestrained discussion, generate ideas.

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.

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

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

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.

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

Curriculum development — The process of creating planned curriculum, pedagogy, instruction, and presentation modes.

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 making — The act of 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 brief — A written plan that identifies a problem to be solved, its criteria, and its constraints. The design brief is used to encourage thinking of all aspects of a problem before attempting a solution.

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.

Developmental level appropriateness — Intended to match the needs of students in the areas of cognition, physical activity, emotional growth, and social adjustment.

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.

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

Educational (instructional) technology — 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 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.

Equitable — Fair, impartial, or just.

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

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.

Expert — Having specialized knowledge and/or ability.

Fair — Not biased or discriminatory.

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.

Forensics — The study of crime scene evidence for use in law, criminal investigation, and/or trial (e.g., gas chromatography or DNA profiling).

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

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

Grade level — A stage in the development of a child's education; a grade (e.g., K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12).

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.

Holistic assessment — 1. Integrates a collection of evidence to get a "big picture" or comprehensive view of what a student understands about a subject. 2. Emphasis of the whole, the overall, rather than analysis and separation into individual parts.

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

Inputs — Something put into a system (such as resources) in order to achieve a result.

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

Intelligence — The capacity to acquire knowledge and the skilled use of reason; the ability to comprehend.

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.

Large-scale assessment — An assessment tool or method that involves a large number of students, such as across a state/province/region or nation.

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.

Level of understanding — A degree of knowledge and/or ability that indicates understanding.

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

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

Measurements — Collecting data in a quantifiable manner.

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 to learn more about what would happen to a similar, real object.

Modification — 1. Changing to ensure accuracy. 2. Adjustment in focus or level of rigor.

Novice — A beginner, one with little or minimal expertise.

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.

Outputs — The results of the operation of any system.

Paper-and-pencil tests — An assessment method that involves the use of questions that are typically answered in a timed setting using paper and pencil.

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 systems 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.

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.

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

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.

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."

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.

Study of technology — Any formal or informal education about human innovation, change, or modification of the natural environment.

Summative assessment — Cumulative 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 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 interdependent 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 assess 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.

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.

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.

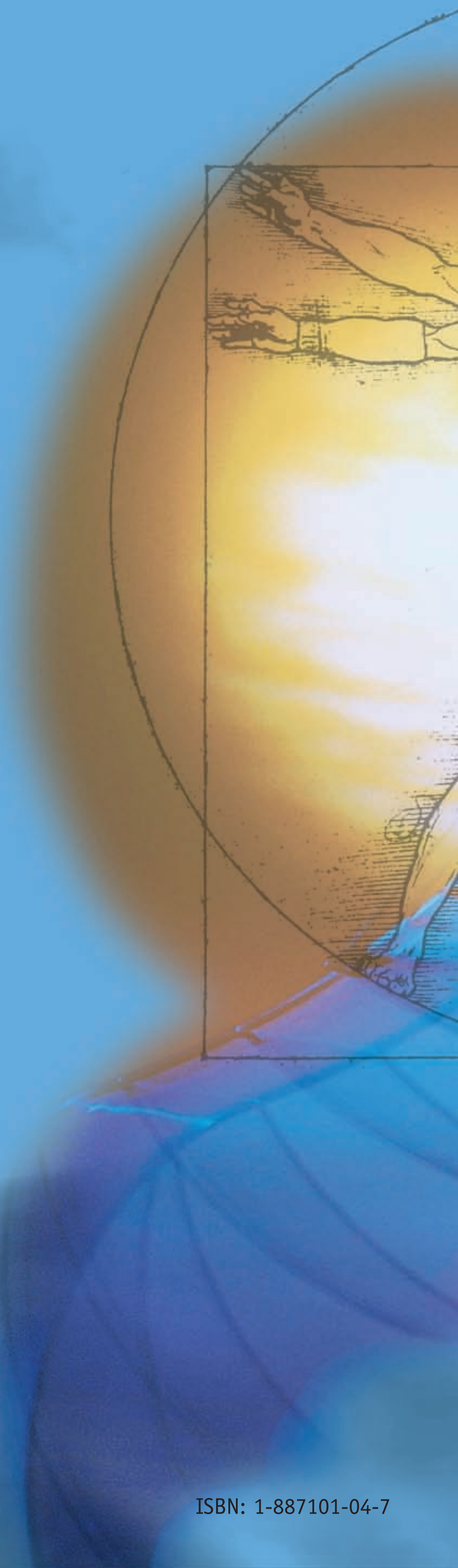
Unit — An organized series of learning activities, lectures, projects, and other teaching strategies that focuses on a specific topic related to the curriculum as a whole.

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

Vignette — A brief description or verbal snapshot of how a standard or group of standards may be implemented in the laboratory-classroom.

Notes:

Notes:



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