New Media and Standards for Technological Literacy

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We live in a world that is increasingly dependent on technology. Technology has been a growing human endeavor since the first chipped-edge flint tool was created by our ancestors about 1.5 million years ago in what is now Kenya. Today, technology exists to a degree unprecedented in history. Furthermore, our technology is evolving at an extraordinary rate, with new technologies being created and existing technologies being improved and extended.

Surprisingly, there is much confusion in today's society about what technology actually is. Is technology computers? Is it new media? Is it calculators? Is it the result of rewiring school buildings to make them Internet accessible? The correct answer to each of these questions is "Yes — and much, much more." Broadly speaking, technology is the way people modify (invent, innovate, change, alter, design) their natural environment to suit their own purposes. From the Greek word *technè*, meaning art or craft, technology literally means the art of making or crafting, but more generally it refers to the diverse collection of knowledge and processes that people use to extend human abilities and to satisfy human wants and needs. From improved communications to new biotechnologies to new wireless networks to new advances in engineering, technology is a key factor in the constant human quest to live longer, more productive lives.

It is particularly important in this technological world that people understand and are comfortable with the concepts and workings of modern technology. From a personal standpoint, people benefit both at work and at home by being able to choose the best products for their purposes, to operate the products properly, and to troubleshoot them when something goes wrong. From a societal standpoint, an informed citizenry improves the chances that decisions about the use of technology will be made rationally and responsibly.

For these reasons and others, a growing number of voices worldwide have called for the study of technology to be included as a core subject in elementary, middle, and secondary schools. Among the experts who have addressed this issue, the value and importance of teaching about technology is widely accepted.

Even with the importance of technology in our lives today, the fact is that the study of technology (technology education) remains a mystery to many teachers and administrators. As a field of study that has evolved over the past 15 to 20 years, technology education is just beginning to establish a new identity that is recognized and understood by people outside the field. There is still widespread misunderstanding about the differences between technology education and educational or instructional technology, a field that uses technology as a tool to enhance the teaching and learning process. There have been standards developed in the United States for both technology education (technological literacy), as well as educational technology. Unfortunately, these may contribute to the confusion in the educational community and the general public.

New Media in Technology Education

Technology education needs media to enhance the teacher learning process within the classrooms and laboratories in grades kindergarten through twelfth. What does "new media" mean exactly? New media refers to an electronic and interactive media as opposed to "traditional" media, such as newspapers, magazines, television, radio, and movies. The traditional media, put out to a broad audience, is identified by the fact that you cannot really select its content for yourself. The new media is characterized by the fact that you play an active role in selecting the precise content that you want to view or listen to. These resources are hopefully updated electronically when there is potential to interact with them. As time goes by, there appears to be more convergence between "traditional" and "new" media. An example of this is that you can get web on your T.V. or T.V. on your computer and digital television is more interactive and has more content than conventional broadcasting.[1] There have been many technology education laboratories and classrooms around the world that use new media in teaching effective content in the study of technology. This is especially true in "modular" labs, which have become popular in certain countries around the world. Unfortunately, there has been little research on whether the new media equipped laboratories and classrooms are more or less effective in producing a more effective environment for student learning than the environment found in traditional settings.

The Study of Technology Resulting in Technological Literacy

The ultimate goal of a school program that involves the study of technology is to provide technological literacy to all students. Technological literacy is the ability of a person to use, manage, assess, and understand technology. A person who is technologically literate understands, in increasingly sophisticated ways that evolve over time, what technology is, how it is created, and how it shapes and is shaped by society. Such a person will be able to hear a story about technology on television or read it in the newspaper and evaluate the information in the story intelligently, put that information in context, and form an opinion. A technologically literate person will be comfortable with and objective about technology, neither scared of it nor infatuated by it.

Because technology is such an important force in our lives and economy, anyone can benefit by being technologically literate. Corporate executives and others in the business world, brokers and investment analysts, journalists, teachers, doctors, nurses, farmers, and homemakers all will be able to enjoy their leisure more fully and perform their jobs better if they are technologically literate.

Standards for Technological Literacy

Recently, the International Technology Education Association (ITEA) and its Technology for All Americans Project have developed and released *Standards for Technological Literacy: Content for the Study of Technology*, which focuses on what every student in grades Kindergarten-12 (ages 5-18) should know and be able to do in order to be technologically literate.[2] Thousands of technology teachers, science and mathematics teachers, and other educators and experts from around the country collaborated to spell out what students in kindergarten (age 5) through 12th (age 18) grade should be learning about technology. This group, along with content specialists and representatives from the National Research Council (NRC) and the National Academy of Engineering (NAE), reviewed *Standards for Technological Literacy* and suggested changes and additions. The resulting document, supported by both NRC and NAE, defines the study of technology as a discipline and provides a road map for individual

teachers, schools, school districts, and states or provinces to develop technological literacy in all students.

Standards for Technological Literacy does more than provide a checklist for the technological facts, concepts, and capabilities that students should master at each level. Along the way, the document explains how and why technological literacy fits with the broad mission of schools and describes the benefits of the study of technology for students. In short, the document makes the case for why the study of technology should be an integral part of the curriculum of our elementary and secondary schools today and in the future.

Architecture of *Standards for Technological Literacy*

The first chapter of *Standards for Technological Literacy* discusses the importance of preparing students to live in a highly technological world. The next chapter provides an overview of the standards and discusses their features and format, as well as the primary users for whom the document was designed. The individual standards presented in *Standards for Technological Literacy* are organized into five major categories, each of which is addressed in its own chapter. These major categories, around which the standards are developed, are the nature of technology, technology and society, design, abilities for a technological world, and the designed world.

The final chapter is a "call to action" for various people within education, the community, and business and industry to work together to promote technological literacy for all students in grades K-12. A comprehensive appendix includes a brief history of the development of the standards, a listing of the standards along with a compendium of the standards and benchmarks, acknowledgements, references, a glossary, and an index.

Standards

Standards for Technological Literacy specifies what every student should know and be able to do in order to be technologically literate and offers criteria by which to judge progress toward a vision of technological literacy for all students. There are a total of 20 individual standards in this document, and they fall into two types: 1) what students should know and understand about technology and 2) what they should be able to do. The first type, which could be termed "cognitive" standards, sets out the basic knowledge about technology — how it works and its place in the world — that students should have in order to be technologically literate. The second type, which might be termed "process" standards, describes the abilities that students should have. The two types of standards are complementary. For example, a student can be taught about a design process during the course of a lecture, but the ability to actually use that process and to apply it to find a solution to a technological problem will come only with hands-on experience. Likewise, it is difficult to perform a design process effectively without having some theoretical knowledge of how it is usually done. (See Figure 1 for a comprehensive list of all 20 standards, also readers may visit the website of the ITEA at www.iteawww.org to view them.)

Benchmarks

The benchmarks in *Standards for Technological Literacy* provide the fundamental content elements that exist as part of the broadly stated standards. Benchmarks are statements that describe the specific knowledge and abilities that enable students to meet

Figure 1 Listing of Technology Content Standards

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.

a given standard, and they are provided for each of the 20 standards at the K-2, 3-5, 6-8, and 9-12 grade levels. The benchmarks are followed by supporting statements that provide further detail, clarity, and examples. An example of a standard and its enabling benchmarks for grades 3-5 is shown in Figure 2.

Figure 2 – A Representative Standard and Its Benchmarks

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

In order to realize the attributes of design, students in grades 3-5 (ages 9-11) should learn that

C. The design process is a purposeful method of planning practical solutions to problems. The design process helps convert ideas into products and systems. The process is intuitive and includes such things as creating ideas, putting the ideas on paper, using words and sketches, building models of the design, testing out the design, and evaluating the solution.

D. Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design. Technological designs typically have to meet requirements to be successful. These requirements usually relate to the purpose or function of the product or system. Other requirements, such as size and cost, describe the limits of a design.

The standards and benchmarks were established to help guide a student's progress toward technological literacy. In developing these standards, the ITEA panel relied on a number of sets of standards in other subject areas, including the *National Science Education Standards*,[3] *Benchmarks for Science Literacy*,[4] *Curriculum and Evaluation Standards for School Mathematics*,[5] and *Principles and Standards for School Mathematics*.[6]

Implications for New Media in *Standards for Technological Literacy*

Standards for Technological Literacy provides the content for what every child should know and be able to do in order to be technologically literate. It does not set forth a curriculum. The curriculum is how the content is delivered day-in and day-out within the classroom. It addresses the structure, organization, balance, and the presentation of the content in the laboratory/classroom from the learner's point-of-view and the desired achievements.

There are two standards that directly relate to new media in the study of technology. They are Standard 4 and Standard 17. Standard 4 states that "Students will develop an understanding of the cultural, social, economic, and political effects of technology." In recent years, we have witnessed a remarkable growth in research addressing the social implications of emerging communication and information technologies. This area often described as "new media" research, is both international in scope and interdisciplinary in approach. With the number of interrelated fields, from communications to the social studies of technology and across an increasing wide range of divisions within the humanities and social sciences, research and teaching in new media are rapidly expanding.

The second direct implication for new media is addressed in Standard 17, which is "Students will develop an understanding of and be able to select and use information and communication technologies." This is one standard in The Designed World that specifically addresses new media. One definition that is given for media is that "it is a term for anything that communicates information." Technology that is used in the information and communication technology will most certainly encompass and embrace all medias, especially those in the new media.

Conclusion

Rodger Bybee, executive director of the Biological Sciences Curriculum Study (BSCS) and formerly executive director of the Center for Science, Mathematics, and Engineering Education at the National Academy of Sciences, recently wrote an article that summarizes the importance of technological literacy in our schools:

> For a society deeply dependent on technology, we are largely ignorant about technological concepts and processes, and we mostly ignore this discrepancy in our educational system. The need to achieve technological literacy is a national imperative. School programs must include technology education.
>
> In this age of international comparisons such as the Third International Mathematics and Science Study (TIMSS), the U.S. stands in stark contrast to most industrialized countries. Japan, Germany, Israel, Australia, the Netherlands, France, Great Britain, New Zealand, and many others have technology education programs. Why the U.S. does not value technology education may have historical precedents, but they are clearly inappropriate to this age. Through support of the new ITEA *Standards for Technological Literacy*, the National Academy of Engineering, the National Research Council, the National Science Foundation, and the National Aeronautics and Space Administration have worked to position technology prominently in our educational system. The proposed National Science Education Acts of 2000 provide federal advocacy, resources, and partnerships for technology education. All of us are now presented with a great opportunity to make technology education an essential aspect of American education.[7]

In summary, ITEA's *Standards for Technological Literacy* provides a foundation for what technological literacy means. And that foundation is based on the vision that the study of technology should be an essential part of every student's basic education.

Our world will be very different 10 or 20 years from now. This is inevitable. However, we have a choice as to whether we march into that world with our eyes open, deciding for ourselves how we want it to be, or whether we let it push us along, as we remain ignorant and helpless to understand where we're going or why. Technological literacy will enable us to make a conscious choice.

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Other Resources:

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