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Roots of Technology Education: Standards Projects

Standards created at the national level began to influence educational policy and practice in the 1980s. Today, 49 out of the 50 states have developed and implemented some form of standards in dozens of subject areas, many of which are adaptations or direct adoptions of nationally developed standards. The roots of standards in technology education go back to the 1970s, with industrial arts education.

Most nationally developed standards are "content standards," which means they focus on basic concepts and "big ideas," deliberately leaving curricular decisions to state and local agencies. Content standards offer a vision for what is needed to enable all students to become literate in a given subject.

Technology education is rooted in standards. This article discusses the evolution of standards in our profession over the past 25 years with specific reference to:

- Standards for Industrial Arts Programs (1978–1981).
- Standards for Technology Education Programs (1985).
- International Technology Education Association's (ITEA) Technology for All Americans Project (1994–2003).
- The future.

Standards for Industrial Arts Programs (1978–1981)

In the late 1970s, the former U.S. Office of Education (USOE) and several professional associations became interested in developing and promoting quality standards for selected subject areas. In 1978, the USOE requested proposals for developing industrial arts program standards. Consequently, the Standards for Industrial Arts Programs Project at Virginia Polytechnic Institute and State University in Blacksburg, Virginia (Virginia Tech) was funded. Per the USOE, the three primary objectives of the project were:

- To **develop a database** on industrial arts programs (as defined in Title 1, Part C, Section 195 (15) of the Education Amendments of 1976) and on industrial arts student organization activities as an integral part of the industrial arts instructional program.
- To **develop a set of standards** and related handbooks for ensuring quality industrial arts programs.
- To **familiarize, publicize, and demonstrate** the standards developed for industrial arts programs.

The database was developed from October 1978 through November 1979. The results of this effort were included in the *Report of Survey Data*, which was published in 1980.

The *Standards for Industrial Arts Education Programs* (*SIAP*) developed by over 400 industrial arts teachers, state and local supervisors, teacher educators, and consultants, served as a model for schools, districts, and states that voluntarily wished to develop, adopt, or refine standards for the improvement of their industrial arts program. The standards are comparative statements that were developed around 10 major topics:

- Philosophy
- Support systems
- Instructional program
- Instructional strategies
- Student populations served
- Public relations
- Instructional staff
- Safety and health
- Administration and supervision
- Evaluation

Under these headings, 235 specific quality measures were listed. These were used to determine if an industrial arts program met, exceeded, or did not meet a standard. Once a determination was made, persons assessing a program prepared a summary profile and wrote summary comments concerning the strengths and deficiencies of the industrial arts program.

Three additional publications were produced by the Standards for Industrial Arts Programs Project as companions to the *SIAP*:

- *AIASA Guide for Industrial Arts Programs.*
- *Sex Equity Guide for Industrial Arts Programs.*
- *Special Needs Guide for Industrial Arts Programs.*

The guides offered suggestions for program improvements related to student organizations, sex equity, and students with special needs. The *SIAP* and its companion documents contained the best thinking of the profession on what industrial arts programs should be and how they could be improved at the time of their publication. In 1981, the Industrial Arts Program at Virginia Tech released *SIAP* to the American Industrial Arts Association (AIAA) for more comprehensive dissemination. The *SIAP* was published in 1981 by Goodheart-Willcox Co., Inc.

Standards for Technology Education Programs (1985)

The *SIAP* was revised by AIAA in 1985 to reflect technology rather than industry. Funding was provided by the Technical Foundation of America. The revised document, entitled *Standards for Technology Education Programs* (AIAA, 1985), had 241 standards and was disseminated by AIAA/ITEA and printed by Goodheart-Willcox Co., Inc. It was during this time that the AIAA changed its name to the International Technology Education Association (ITEA).

ITEA's Technology for All Americans Project (1994–2003)

Motivated by the growing need for technological literacy for all citizens, ITEA formed the Technology for All Americans Project to provide formal structure for technology education programs across the country. The project's goal was to create standards for technology education for grades K–12. Funded by the National Science Foundation and the National Aeronautics and Space Administration, the project commenced in 1994 with the first of three phases.

- **Phase I—*Technology for All Americans: A Rationale and Structure for the Study of Technology* (*RSST*, 1994–1996)**

RSST (ITEA, 1996) established the fact that technological literacy is much more than just knowledge about computers and their application. It defines technology as "human innovation in action" (p. 16) and creates a vision where each citizen should have a degree of knowledge about the nature, behavior, power, and consequences of technology from a broad perspective. Inherently, it presents educational programs where learners become engaged in critical thinking as they design and develop products, systems, and environments to solve practical problems. This phase provided a firm foundation for Phase II of the project, the development of content standards.

- **Phase II—*Standards for Technological Literacy: Content for the Study of Technology (STL* 1996–2000*)***
  STL (ITEA, 2000) was released at the ITEA conference in Salt Lake City in April 2000. In the review and consensus-building process, more than 4,000 people contributed to the improvement of the document as it was developed and refined, including educators, administrators, and experts from the fields of science, mathematics, and engineering, among others. *STL* is endorsed by both the National Research Council and the National Academy of Engineering. There are 20 technology content standards (see Table 1). They are divided by the grade levels of K–2, 3–5, 6–8, and 9–12 and consist of written statements about what is valued in the study of technology. These standards set forth goals to be met in five major categories of technology: the nature of technology, technology and society, design, abilities for a technological world, and the designed world.

Nearly 300 benchmarks play a vital role in *STL*. Benchmarks are statements that enable students to meet a given standard. They are articulated or "ramped" from grades K–12 to progress from very basic ideas at the early elementary school level to the more complex and comprehensive ideas at the high school level. The benchmarks contain certain core content "concepts," such as systems and processes, that extend across various grade levels to ensure continual learning of an important topic related to a standard (see Table 2).

Table 1. The Standards for Technological Literacy

The Nature of Technology (Chapter 3)
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 (Chapter 4)
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 (Chapter 5)
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 (Chapter 6)
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 (Chapter 7)
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.

Table 2. A Representative Standard and Its Benchmarks

Standard 11. Students will develop abilities to apply the design process.
As part of learning how to apply design processes, students in grades 6-8 should be able to

H. Apply a design process to solve problems in and beyond the laboratory-classroom. Perform research, then analyze and synthesize the resulting information gathered through the design process. Identify and select a need, want, or problem to solve, which could result in a solution that could lead to an invention (an original solution) or an innovation (a modification of an existing solution). Identify goals of the problem to be solved. These goals specify what the desired result should be.

I. Specify criteria and constraints for the design. Examples of criteria include function, size, and materials, while examples of constraints are costs, time, and user requirements. Explore various processes and resources and select and use the most appropriate ones. These processes and resources should be based on the criteria and constraints that were previously identified and specified.

J. Make two-dimensional and three-dimensional representations of the designed solution. Two-dimensional examples include sketches, drawings, and computer-assisted designs (CAD). A model can take many forms, including graphic, mathematical, and physical.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. Testing and evaluation determine if the proposed solution is appropriate for the problem. Based on the results of the tests and evaluation, students should improve the design solution. Problem-solving strategies involve applying prior knowledge, asking questions, and trying ideas.

L. Make a product or system and document the solution. Group process skills should be used, such as working with others in a cooperative team approach and engaging in appropriate quality and safety practices. Students should be encouraged to use design portfolios, journals, drawings, sketches, or schematics to document their ideas, processes, and results. There are many additional ways to communicate the results of the design process to others, such as a World Wide Web page or a model of a product or system.

- **Phase III—Companion Standards to *STL* (2000–2003)**
  The final phase of the Technology for All Americans Project is to develop a companion document for *STL* articulating the standards for assessment, professional development, and programs. The assessment standards are designed to address specific goals and purposes and define who to test, when to test, and what kind of test to use. Professional development standards are performance based and describe the attributes and skills that teachers should acquire as the result of professional development. They apply to every teacher in the schools who is teaching any aspect of technology. And finally, program standards address the totality of the school program across grade levels.

The Future

In 2003, the companion standards to *STL*—assessment, professional development, and programs—will be completed and mailed to approximately 6,500 classroom technology teachers, supervisors, and teacher educators. An additional 2,000 copies will be mailed to key school administrators and policymakers. The standards will be published by ITEA as well as placed on ITEA's Internet site (*www.iteawww.org/TAA/TAA.html*).

STL and its companion standards do not present an end but a beginning. In other fields of study, the development of standards has often proven to be the easiest step in a long and arduous process of educational reform. Getting *STL* and the three sets of companion standards accepted and implemented in grades K–12 in every school is a challenge ITEA intends to accept in striving for technological literacy for all citizens.

References and Resources

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both felt that the front end material of the Jackson's Mill document was timeless but that the content organizers and processes were beginning to become dated. Also, we felt that the field was beginning to ask, "What comes after Jackson's Mill?" Certainly the work that Tom Wright spearheaded with the Chicago 10 Curriculum Implementation Project operationalized Jackson's Mill, but it could go no further than the work that it was attempting to "hang" a curriculum upon. At the Mississippi Valley Industrial Teacher Education conference that following November, we approached Gene Martin for his perspective regarding the possibility of having the Technical Foundation of America (TFA) fund such an effort. Due to his encouragement to us to submit a proposal, the TFA funded our effort and allowed us to begin the process at the ITEA conference the following spring of selecting 25 leaders in the field to participate. Tom Erekson, Tom Wright, and Kendall Starkweather served as trustees for the project and assisted provide a framework for the study of technology in the 1990s.

A Conceptual Framework for Technology Education endorsed the human adaptive systems and domains of knowledge of the *Jackson's Mill Industrial Arts Curriculum Theory* (Snyder & Hales, 1981) while also focusing on the human as a problem solver who, through the application of the technological method model, could identify and address problems and opportunities and solve problems using resources and technological processes while considering the outcomes and consequences of such activity. The significant contributions of this document are the listing of the universal attributes of technology; the comparison of the features of the body of knowledge of technology to the features of science and the humanities/arts (see Figure 1); the development of the technological method model (see Figure 2) and its "spin-off"—a model for technology education (see Figure 3); the inclusion of a broader base of content for the study of technology: the recognition