Rapid changes and innovations in technology impact all segments of society, including education. They provide teachers with new ways to deliver instruction but at the same time, they frustrate teachers’ attempts to help students understand and use technology. Since the days when technology began to change the delivery of education, teachers have struggled with how to incorporate this unwieldy subject into the curriculum. The problem: Technology is continually changing, so our efforts to prepare students adequately must constantly change as well. Although this is a challenge, technology can be used to improve the delivery of instruction and to motivate and engage students.

When discussing Technology Education, a clear definition is vital because it is easy to confuse terms and concepts that sound similar but have very different meanings. The term Technology Education is quite different from Education Technology. The latter consists of various technologies used in the delivery of education, such as iPads, projectors, the Internet, and computer hard-

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Technological Literacy: Why Is It Important?
A technologically literate person understands how technology is created, how it shapes society, and how it is shaped by society. Such a person will acquire an objective view of technology—neither frightened by it nor infatuated with it.

Educational technology and the delivery of education are the primary focus of the International Society for Technology in Education (ISTE). Technology Education consists of curriculum and educational experiences relating to the history, understanding, and use of technology.

With the accelerating pace of technological development, educators have long wondered how to respond. This concern in the United States finally stimulated the Technology for All Americans project, which was published in 1996.1 This document served as a foundation for the Standards for Technological Literacy that established guidelines for what technologically literate students should know and be able to do.2

In his foreword to the Standards for Technological Literacy, William A. Wolf, the president of the National Academy of Engineering, explained his understanding of the problem: "We are a nation increasingly dependent on technology. Yet, in spite of this dependence, U.S. society is largely ignorant of the history and fundamental nature of the technology that sustains it."3

The technology standards are organized into five major categories:4

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

Within these five categories, there are 20 standards and benchmarks for grades K-12, with a narrative “describing where and how this standard should be presented within the laboratory-classroom experience at each grade level. Also included is a Vignette, which gives ideas or examples of how standards can be implemented in the laboratory-classroom.”5

These standards are written in a broad and inclusive manner that accommodates diverse approaches in the curriculum.

For example, one of the standards for the first category, The Nature of Technology, states that “students will develop an understanding of the characteristics and scope of technology.”6 For the K-2 level, students are to learn that “the natural world and the human-made world are different,” and that “all people use tools and techniques to help them do things.”7

Similarly, students in grades 9-12 will understand the standard projects that: “the nature and development of technological knowledge and processes are functions of the setting”; “the rate of technological development and diffusion is increasing rapidly”; “inventions and innovations are the results of specific, goal-directed research”; and “most development of technologies these days is driven by the profit motive and the market.”8

Each of these understandings is followed by pertinent examples of how the concept applies to real-world issues.

Although the standards were developed some years ago, they are now receiving new attention through the focus on the Science, Technology, Engineering, and Math (STEM) movement as new technology develops in these fields.

Examples

Because standards serve only as guidelines for Technology Education, they allow for diversity in implementation. A good example of the implementation of Technology Education can be found at the Central Dauphin School District in Harrisburg, Pennsylvania. Their Website provides detailed information on how Technology Education is implemented in their district with detailed information on courses and videos on the various activities of the classes.9

Tom Ogle, Technology-Education instructor at Warner Middle School in Farmington Hills, Michigan, inherited a traditional industrial-arts shop that included woodworking, metalworking, and drafting facilities.10 He updated the
curriculum in order to teach industrial technology through the use of the Standards for Technological Literacy. He now incorporates high-tech design through CAD (computer-aided design) and uses 3D printers and CNC (computer numeric control) machining to produce prototypes of student-designed products. This exemplifies how schools can use the Standards for Technological Literacy to keep programs up to date with modern technology.

The possible variations in how Industrial Technology or Industrial Arts/Technology Education can be integrated into the curriculum are innumerable, which is good news for anyone interested in developing such a program. The curriculum for the elementary grades is relatively easy to implement, with minimal requirements for teacher training and equipment. In the higher grades, it may be necessary to invest in teacher training and laboratory facilities in order to deliver the appropriate hands-on activities. The problem is that many of the higher-level activities require specialized equipment and lab space, as well as instructors with appropriate experience. The ideal approach for the higher grades is to convert an existing industrial-arts facility to use with the Technology Education curriculum. Even if a school has not had any type of hands-on program before, implementation is not impossible, but the institution will doubtless experience limitations while it seeks to acquire sufficient laboratory space, equipment, and qualified faculty.

Educational Benefits

While Technology Education programs are designed to provide basic competence in technology, student involvement affects learning outcomes. The human variables include student motivation as well as variations in learning styles, which are often neglected in the typical academic setting.
In the recent quest to meet the demands of accountability through the intensification of standardized testing, researchers are finding that students are not as interested in learning as they once were. According to one researcher: “The most pressing problem in education today is student disengagement.” In addition, fewer students are interested in pursuing engineering and science careers. But perhaps the most alarming development is increased technological illiteracy—people lacking the knowledge/training to perform the most basic tasks, such as changing the oil in a car, fixing a leaky faucet, or dealing with a myriad of other common problems that arise in daily life.

In the past, students acquired basic design, construction, and maintenance skills that enabled them to diagnose problems and to repair their homes, cars, and appliances. They learned how to master new technologies and to use them to enhance their lives. However, more recently, industrial arts and vocational programs have been systematically eliminated in order to make way for “more intellectual pursuits.” In this new paradigm, which provides no clear connection between the practical and the intellectual, students are becoming disengaged, finding it difficult to see the value of technical learning and unable to make connections between academics and everyday life.

Quality Technology Education programs help engage students in the learning process by providing hands-on activities that connect theory with practice. In a Technology Education classroom-laboratory, students can experience technology through practical applications of the processes and procedures used in the production of items we use daily. The tangible results makes theory come alive.

Technology Education ensures that students are technologically literate and able to do the following:

• apply a range of practical hands-on technological skills;
• identify and fix simple mechanical or technological problems at home and work;
• apply basic mathematical concepts related to probability, scale, and estimation to make informed judgments about technological risks and benefits;
• use an analytical thinking process to solve problems in daily life; and
• obtain reliable information about technological issues of concern from a variety of sources.

These experiences also develop critical thinking and decision making, enabling young people to ask pertinent questions and evaluate information about the benefits, risks, costs, and trade-offs of technology. In the process, they are encouraged to participate in decisions about the development and uses of technology. Technology Education also promotes the development of visualization and spatial skills that are necessary in most other disciplines.

Furthermore, these experiences also promote career-development awareness and give students a realistic perception of the tasks and skills required for various professions and trades. This practical application phase of technology provides students with a better-rounded view of technology-related careers and what people do in them. Being able to explore career choices in this way gives students realistic insights...
qualified instructors in inadequate facilities.

Technology Education and Character Development

Character development is another component of Technology Education, a concept that was strongly endorsed by Ellen White, who spoke highly of the benefits of what in her day was referred to as “manual training.” These experiences are of great benefit to students because they prepare them for the realities of life and the discipline of work, and help to develop “common sense.”

“The benefit of manual training is needed also by professional men. A man may have a brilliant mind; he may be quick to catch ideas; his knowledge and skill may secure for him admission to his chosen calling; yet he may still be far from possessing a fitness for its duties. An education derived chiefly from books leads to superficial thinking. Practical work encourages close observation and independent thought. Rightly performed, it tends to develop that practical wisdom which we call common sense. It develops ability to plan and execute, strengthens courage and perseverance, and calls for the exercise of tact and skill.”

During the past few decades, the trend in K-12 education has been to do away with industrial-arts offerings for a variety of reasons, primarily because they have been viewed as outdated or irrelevant. However, there is still a need for this component of education. It is important to combine theory and academics with skill development to enable students to benefit from ideas and their practical applications. This approach will help to provide a balanced education and enable students to make a clear connection between learning and life. However, Technology Education must not be just a “shop class” doing business as usual under a new name, or a smattering of low-level hands-on experiences offered by unqualified instructors in inadequate facilities.

How to Start

How can you begin a program in your school? First, obtain a copy of the Standards for Technological Literacy and an overview of the K-12 standards and current curriculum implementation efforts in various fields. The means of delivery will vary from school to school because of the endless possibilities in how these standards can be addressed. Teacher qualifications as well as equipment and facility requirements may present some concerns due to the variety of technologies involved, particularly in small schools. (A list of resources is provided above.)

Conclusion

Technology currently has and will continue to have a profound impact on our world. As educators, how will we respond? Will we equip young people to effectively understand and use technology? In the past, industrial-arts pro-
grams were designed to help students understand and use the technology of the early- to mid-20th century. Now we face a myriad of new products and technologies yearly, so students need the skills and creativity to respond in appropriate and creative ways.

This new form of hands-on education provides many enhancements to the student’s overall educational experience. In the past, manual-training and industrial-arts programs sought to prepare youth to meet the changes in their world to transform them into informed consumers equipped with practical skills to meet the challenges the new technologies brought to society. Technology Education, the contemporary equivalent of those programs, can equip and motivate students to understand the relevance of the theories they are learning in other academic classes. Practical experience in using and managing technology enables students to find ways to make technology beneficial to their professional and personal lives. Technology Education also provides additional benefits to the student’s educational experience through character development and career awareness. Some may use their newly acquired skills to earn part of their tuition while attending higher education.

Educators must embrace hands-on Technology Education. Implementing a new program or evolving an existing industrial-arts program is not only worthwhile, but also a relatively manageable task. When this is correctly understood and implemented through the Standards for Technological Literacy, this practical component of learning will contribute to the holistic education of students.

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