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ABSTRACT

With technology constantly changing, educators are challenged to integrate technology education into the curriculum. In an effort to integrate a study of technology into the public school curriculum, educators at the University of Idaho identified the following areas as representative of modern technology literacy: computers and computer-aided drafting, robotics, principles of technology, and computer numerical control technology. In order for educators to remain abreast of new developments and to present them effectively to their students, they may need to attend workshops or conferences, and then, with limited resources, try to integrate new knowledge into a traditional curriculum. Others may need to enroll in graduate programs and pursue advanced degrees. All must constantly read and reflect on professional and technical journals. The University of Idaho is working with teachers throughout the state to assist them with the modernizing of the curriculum and is presenting workshops, seminars, and summer programs on technology in the curriculum. (KC)

TECHNOLOGY EDUCATION: THE TRANSITION

Paper Presented at the Phi Delta Kappa,
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INTRODUCTION

No other effect has been as pronounced on our society in the 20th century as has technology. Technology is changing the way we live, the way we work, and the way we play. A review of the evening newspaper or monthly news journals is seldom without reference to the rapid advances of technology in lasers, telecommunications, computers, robotics, and biomedicine. We sense the impact of technology on the changing workplace where electronic mail, the automated office, desktop publishing, computer aided manufacturing are becoming increasingly important. We stand back in awe when technology comes together in something as breath-taking as the space vehicle that carried the first man to the moon. If we are to keep up with technology , to control it and to use it for the improvement of our society, we need to understand it. More importantly, we need to communicate it to our students in such a way that they can understand and learn to use it effectively and creatively as the leaders of the 21st century (Pedras et al, 1987).

Technology education may be viewed as a national concern, as a mission for education, and as a stimulus for a new curriculum with new goals directed toward technological literacy (Hacker & Barden, 1987). In the words of David Goetsch, Director of Technology at Okaloosa-Walton Junior College, Florida (1988), "technology . . . fully permeates all aspects of our lives." In essence, then, it is readily apparent that technological literacy is a skill that all students will need to have in order to survive in our modern technological society.

In an effort to integrate a study of technology into the public school curriculum, several areas have been identified as representative of modern technology literacy and are discussed below. These should not be construed as all inclusive but rather representative of those that can and should be present in a technology-based industrial studies curriculum.

COMPUTERS AND COMPUTER AIDED DRAFTING

Computer applications in business and industry are expanding and changing the nature of work and skill of the work force. Increasing use of computers in industry is the most important factor that encourages utilization of computers by industrial technology educators. The most common computer applications in technology education are computer-aided drafting (CAD), computer-aided manufacturing

(CAM), word processing, and graphic communication applications.

A survey of vocational instructors (Dickinson 1985) revealed that nearly all respondents believe that there is a need for microcomputer-based CAD in their schools. Of the 436 respondents, 93 percent indicated a need for microcomputer based CAD at their institutions, less than 15 percent reported the availability of a large-scale CAD system in their schools, while 45 percent had access to some type of microcomputer-based CAD system for instructional use. The majority of instructors surveyed stated that funding problems and lack of other compatible equipment were the major reasons that CAD was not used more widely in their schools.

Computer-aided drafting (CAD) is a relatively new technology that gives students the ability to create a drawing representation of a design on a monitor connected to a computer. Computer graphics systems are widely used for all types of graphics work, where time savings, precision and uniformity are needed in creation of drawings. The type of work done on a CAD system includes two and three dimensional mechanical drafting, electrical schematic drafting and design, printed circuit board, and layouts in architectural design. A CAD system is comparable to a medium sized computer with a central processing unit, disk drive for storage, and other graphics devices such as a display screen, plotter, mouse and digitizer which are used for input and output from and to the computer.

Even though computer-aided design was introduced over two decades ago, only in the last few years has this technology been used widely by the industry and manufacturing companies. CAD offers increased productivity, increased quality, lower cost and improved standardization for industries and its users. CAD is becoming an important part of the curriculum in secondary and post-secondary technical programs and offers challenge and opportunity for both students and teachers of technology education.

ROBOTICS

While a discussion of the historical definition of what constitutes a robot will not be given, it is necessary to have a working definition of what we call a robot. According to Osborne (1987) a robot is "a machine which automatically moves items, not part of itself, to positions chosen by the robot programmer and which gives the programmer a variety of positions to choose from." It may be inferred from this definition that a robot is a machine which performs work for mankind. This work includes welding, machining, moving items from one place to another

and painting. The work is frequently performed in dirty or dangerous environments and may be dull and repetitious.

Robotics study in the Industrial Technology Education program at the University of Idaho includes a mixture of theory, simulation and hands-on activities. These aspects of robotics are included in electronics and manufacturing coursework.

All majors are expected to graduate with a working knowledge of robotics and teacher education candidates should be able to integrate this knowledge into the public school technology curriculum. Teachers are further assisted in this effort after graduation by participating in in-service workshops through our program.

It is apparent that robots will become an increasingly important part of American industry. Future uses envisioned are fire-fighting, mining, nuclear waste handling, fruit picking, etc. Imagination and the development of more discriminating sensors are what stand between us and more advanced uses of robots today.

One reservation that is made about robotics in education is that, while robots may become more pervasive, the number of persons employed in robotics will be smaller than other segments of American business and industry. While this may be true, the numbers will continue to increase and the relative importance of such trained persons offsets their smaller numbers.

In an effort to keep our university technology curriculum current, a study of robotics will include instruction in hydraulics and pneumatics, additional electronics coursework and more examples of robotics in systems. Technology teacher education candidates will be expected to have a working knowledge of robotics and be able to integrate this new field of study into traditional programs.

PRINCIPLES OF TECHNOLOGY

Principles of Technology is an area of study which helps students who are planning careers in technology or the teaching of technology to keep pace with the numerous changes occuring in technological related fields. It blends an understanding of basic principles with practice in practical applications. It is designed to give a firm foundation for understanding todays technology and tomorrows advancements in technology.

This newest addition to the modern technology curriculum is consistent with the current definition of technology which is the application of scientific principles to the solution of everyday problems (Goetsch, 1988). In

other words, technology is applied science (Goetsch & Nelson, 1987).

Principles of Technology is designed around 14 major units of instruction, each of which focuses on one of the important concepts that undergird modern technology. These units include: Force, Work, Rate, Resistance, Energy, Power, Force Transformers, Momentum, Waves & Vibrations, Energy Convertors, Transducers, Radiation, Optical Systems and Time Constants. These units are studied within the context of four major systems which make up all of our technology. These include: Mechanical Systems, Fluid Systems, Electrical Systems and Thermal Systems.

A combination of theoretical scientific concepts, applicable math concepts and lab experiments are used to help students understand and apply what they learn. A series of short video tapes are also available to augment each unit of study.

The course is designed to be used in the last two years of high school but elements can be adapted and used at other levels of instruction. The basic concepts can also be integrated into other areas of study such as communications, manufacturing, construction and power-energy-transportation.

The design of the course is for the expressed purpose of:

- increasing the eventual employability of students.
- emphasizing principles rather that specifics of technology and provide an understanding of the mathematics associated with these principles.
- increasing the appeal of instruction by using an interest-holding instructional system incorporating video presentations, demonstrations, hands-on lab exercises, special exercises for students requiring additional help in mathematics, recommendations for "teaching paths" for the teacher and "learning paths" for the students, and a teachers's guide that explains how to orchestrate the learning package.
- maintaining the academic rigor needed to meet the increased requirements for high school graduation.

Principles of Technology was taught during the summer of 1987 for the first time as an in-service course for practicing teachers. It is currently being taught as a full semester course and will be required of all in-coming industrial technology education majors effective 1988.

The addition of this area of study should serve to build upon the science background of teacher education candidates and assist them to effectively teach and apply basic science concepts. In this way, students should be able to transfer knowledge to numerous technological areas of study.

COMPUTER NUMERICAL CONTROL TECHNOLOGY

Computer numerical control (CNC) has been the major concept among the forces driving the metalworking industries across the threshold into a new era. Closely coupled with the booming technologies of micro-electronics and computers, it has truly revolutionized manufacturing and for this reason it is now part of most industrial technology education curriculums.

This control technology is the operation of a machine by a series of coded instructions comprised of numbers, letters and special symbols. These are translated into pulses of electrical current or other output signals that activate motors and other devices which run the machine.

Carried to the ultimate, computer numerical control is the operation of an entire manufacturing plant by means of many computers and numerical control units interacting with each other; that is, "talking" to each other by an appropriate machine language.

This high technology addition to manufacturing has provided numerous advantages to the industry and is virtually changing the way goods are produced. For example, much flexibility is required for small productions runs. CNC can provide the automation to modify or convert production from model to model or from one workplace to another. Set-up time is reduced as CNC is adopted thus decreasing down time which produces no product. Complex designs can be machined easily through appropriate programmed sequences with repetition limits virtually eliminated. Tooling cost are reduced by decreasing the need for jigs and fixtures. Finally, quality of production is increased because pre-programmed instructions are followed, error free, by the machine.

This area of study has been added to our curriculum through the use of innovative hardware. Due to the prohibitive costs of full size CNC machines, several desktop models are in use for instructional purposes. These are controlled with either PC computers or self-contained numerical control programs. The units are available for student use under controlled conditions and will provide prospective industrial technology education majors with examples of equipment that they may wish to incorporate into their future teaching.

SUMMARY

Few if any areas of study have experienced the phenomenal growth of knowledge that technology education is currently experiencing. Recently, at a national

conference, one speaker said that state-of-the-art for his company is 90 days. Another said that we are rapidly passing through the age of communication and into the age of light.

It is difficult for industrial technology educators to remain abreast of new developments and to present them to students in such a way that technological literacy will be within the grasp of all who are interested. For many teachers, it means attending workshops or conferences and then, with limited resources, try to integrate new knowledge into a traditional curriculum. For others it means enrolling in graduate programs of study and pursuing an advanced degree. For all, it means constantly reading and reflecting on professional and technical journals.

The University of Idaho is working with teachers throughout the state in an effort to assist them with the modernizing of present curriculum. Topical areas such as those presented in this paper are being integrated into the teacher education curriculum and made available to practicing teachers through workshops, seminars and summer programs of study.

This paper discussed only a few of the new areas of technology which teachers may wish to add to their programs. Only by doing this will the public school technology program bring to students an opportunity for technological literacy and survival in our modern technological society.

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