Technology and the Secondary Curriculum

By Laun L. Reinholtz

The Pilgrims found that survival in America depended upon their ability to cope with a new environment in providing shelter, clearing land, and growing crops. As more settlers arrived the colonies became better established with the help of special goods and services provided by millers, blacksmiths, wagonmakers, leatherwrights, and others. The farmers needed these services and became dependent upon them to help improve their lives.

The society of the early settlers was almost totally agrarian, but as the colonies became established, more people moved into occupations outside of farming. The Industrial Revolution began with the birth of the machine age, which reached its peak about 1920 and precipitated many changes in society. Once begun, the revolution shifted America from an agrarian to an industrial society over a period of approximately 100 years. At its peak more than 50 percent of the work force was involved with the manufacture of goods.[1]

In the short span of about 20 years American society has gone through another revolution—a technology revolution. We have moved from an industrial to an informational society. By the beginning of the twenty-first century only 2 percent of our work force will be required in agriculture and 22 percent in manufacturing; 66 percent or more will be employed in information-related occupations.[2]

> Technology has done more to change the way we live than all other forces. . . . While science has made enormous contributions by providing us with 'truth' or 'what is,' technology has made its impacts by providing us with 'know how' or knowledge of efficient and appropriate action.[3]

Picture removed

In the short span of approximately 20 years American society has . . . moved from an industrial to an informational society.

Technology in its simplest terms may be described like this: To obtain orange juice one may use the mouth, hands, and teeth to extract the juice, or use an orange juice squeezer. The former is natural; the latter requires the use of technology. Through technology human beings manipulate God's laws and materials in an attempt to better their environment.

In coupling science and technology, humankind has made tremendous strides in space travel and exploration. In 1957 the Russian launch of the first satellite caused tremendous excitement and curiosity on the part of the American people. Today, more than a decade after American astronauts walked on the moon, we view space launches as a common occurrence.

To survive the manufacturing crunch, industries are engaging robotics along with computer-aided design/computer-aided manufacturing (CAD/CAM) to produce better quality goods using fewer people. Jobs that once took an engineer months to complete can now be done in days by the use of computer-aided design.

Currently, medical doctors are experimenting with CAD/CAM systems to help them design artificial joints that more closely match their patients' needs. An X-ray is made of the joint along with information from a CAT

Dr. Laun L. Reinholtz is Chairman of the Department of Technology at Andrews University, Berrien Springs, Michigan.

scan. The weight and activity level of the individual is fed into a computer, which designs the type of joint needed. When the doctor is satisfied with the design, the information is sent to computer-operated machines that automatically produce the parts needed for the new joint.[4]

In the past, if a person could read and write he or she was considered literate. When the banking system became widespread, literacy included writing checks and balancing a checkbook. In today's society, literacy includes the use of the computer. Richard Hersh even goes further by stating that literacy is the

> possession and access to the competencies required not only to read and write, but to sort, analyze, and synthesize a virtual bombardment of information. . . . 'Technology literacy' then means the competence required to engage in complex thinking. It entails possession of the appropriate knowledge and skills to access a continuously changing base of information.[5]

As teachers and educators we must help our students adjust to the new technologies. If we fail to do so they will be manipulated by technology and will not be in control. According to Timothy Jay,

The first step in helping our students become aware of technological advances is for each of us, as educators, to learn about the latest technological advances in our own fields.

> It is too easy for most of us, especially as we mature, to fall behind in our knowledge of technological advances. This attitude or lack of commitment to self-education is compounded over time, and we begin to sense that we are falling further behind, such that life appears to advance at an accelerating pace. The system does not wait for us to catch up; it keeps evolving, resulting in either a feeling of *control* for the educated or feelings of *manipulation* for the ignorant. We develop as either agents or instruments in technology. There are no innocent bystanders.[6]

How can teachers help their students become technologically literate? Currently the secondary curriculum is so structured and full, that expecting all students to complete a technology class might create more problems then it would solve. A better approach would be integrating technology into the subjects currently being taught. The first step in helping our students become aware of technological advances is for each of us, as educators, to learn about the latest technological advances in our own fields. Many ideas from journals and magazines can be incorporated into the classroom.

How teachers present current technological developments, which are rarely included in textbooks, will depend upon their area of concentration and classroom structure. Two simple approaches might be considered. First, set aside a short period of time each week for relating new developments to material currently being taught. Second, encourage students to bring in articles about new developments that relate to your class and spend a few minutes sharing these with the group. But be careful, students may bring in more material than can be used!

At this point some teacher may demur, "But technology is not related to the subjects I teach!" It is true that all emerging technological developments can credit their development to math, science, and computers. Because of this it would seem to be easier to integrate technology into these subject areas than others in the secondary curriculum. However, creative teachers in other disciplines will be able to find ways of incorporating technology into their classroom activities.

English Class

For example, English can easily encompass new technologies in research and report writing. This approach often excites interest and makes students want to go beyond the required assignment because they are learning about the latest technological developments and the implications these might have for their world. However, the teacher may have difficulty evaluating the student's research work and assessing how well he or she covered the topic unless the teacher has studied the area of technology in which the student did the research.

Using the technology education approach allows the teacher flexibility in challenging both the fast and slow learner by helping each to select topics matching his or her abilities.

Social Studies

Social studies offers a golden opportunity to look at technology from a historical perspective. Doing so may require a slight shift in the teacher's approach, but emphasizing changes in the world due to technological advances and tracing dates of inventions and their effects on us shed a great amount of light on the past. This can make social studies more interesting.

A complex problem in studying technological advancements is addressing problems brought about by technology. When Dr. C. N. Barnard performed the first human heart transplant, or when the heart of a baboon was transplanted into "Baby Fae," ethical issues surfaced that needed answers. These topics make excellent material for serious classroom discussion and research. By spending time on technological issues, students begin to see how technology may or may not always be the best way to human advancement. Such study will help students become more aware of technological developments and their effects on society.

Frequently the more current or futuristic a topic becomes, the more interest it sparks in a student.

Bible Class

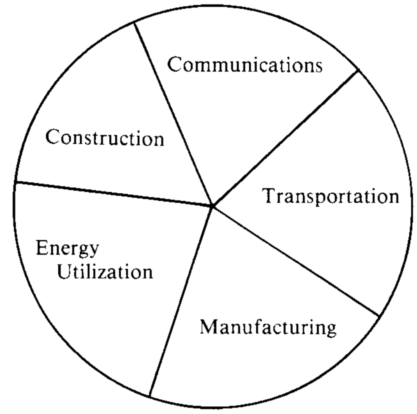
Bible class offers the perfect time to discuss ethical dilemmas. Many times these deal with interpersonal relationships, and in this context students need to see how Christian principles can be applied to the problems technology has created. Of course, advancement of technology can also be tied into signs of Christ's second coming and closing events before His return.

In North America most secondary curricula require one unit of applied arts in the ninth or tenth grade. Generally this is fulfilled by an industrial arts shop class or a unit in home economics. In many cases the shop class may cover a large number of topics such as drafting, woodworking, metals, power mechanics, graphic arts, crafts, electrical/electronics, carpentry, home mechanics, and other areas, depending on the interest and expertise of the teacher. Unfortunately, many such classes have not been very stimulating because the industrial processes studied did not incorporate current technology. If students are learning about drafting, the curriculum should include the basic drafting concepts and the latest technology in computer-aided drafting (CAD). If possible, students should do a drawing or two using a computer. If equipment costs are prohibitive, the class could take a field trip to see computer drafting in use.

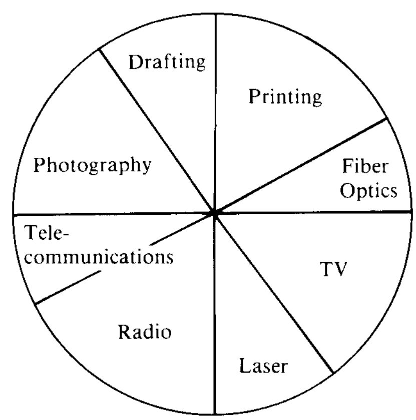
In woodworking classes, where students learn to use hand and power equipment, they need to understand how the computer has changed industry in the control and operation of power equipment. General shop classes can be made exciting if they are oriented toward technology education. This requires teaching the basic processes as well as integrating modern technology into the class so students learn how technology has changed our society and where it might take us in the future.

Using this approach, students would move through preplanned experiences geared to help them understand current technologies. The project, which in the past has been the main emphasis, would now be used simply as a vehicle to assist the student. The technological approach would center around large cluster areas, using technologies relating to each area to make it easier for the student and teacher to organize and study the topic. For example, the large cluster area could be:

How teachers present current technological developments . . . will depend upon their areas of concentration and classroom structure.



Each cluster is divided into small subgroups that allow for both breadth and depth. The time spent in each cluster is flexible; one semester would be ideal to assure exposure and understanding. Any school can offer these classes on an alternate-year basis to allow a wider class offering. Communications could be subdivided into:



In each of the following subgroups students would become involved in activities that would give them answers to the following questions:

1. What are the job possibilities?
2. What is involved in work in a particular area?
3. What current technologies are used in this field?
4. How have these technologies changed our society?
5. In terms of selected psychomotor activities, what skills are needed for working in a given area?

The learning activities used in each area would vary from cluster to cluster with each contributing to the student's learning the five items listed above. Activities would center around research papers, models, projects, experiments, interviews, oral reports, field trips, and other meaningful experiences. In each of these the teacher serves as a facilitator, not a resource person, guiding the students as they seek to answer their own questions.

The 1984 Illinois State Curriculum Guide for ninth and tenth grade industrial arts programs[7] offers a good example of a one-semester course in communication technology, which is outlined below:

I. The World of Communication (one week)
   A. Definition of communication technology
   B. Communication model
      1. Sender
      2. Channel
      3. Receiver
      4. Feedback
      5. Interference/noise
   C. History and development
   D. Career awareness

II. Design/Drafting (two and one-half weeks)
   A. Visualization
   B. Sketching
   C. Creative problem-solving
   D. Elements and principles of design
   E. CAD systems
   F. Impact of design and drafting
   G. Career awareness

III. Broadcasting (TV and/or radio) (two and one-half weeks)
   A. Role of broadcasting in communication
   B. Planning and preparing a broadcast production.
   C. How a system (TV and/or radio) works
   D. Production techniques
   E. Impact of broadcasting
   F. Career awareness

IV. Computers (two and one-half weeks)
   A. Applications for industry
   B. How a computer works
   C. Future prospects
   D. Programming
   E. Data processing and word processing
   F. Impact of computers
   G. Career awareness

V. Photography (two and one-half weeks)
   A. How a camera works
   B. Principles of light in photography
   C. Applications in industries
   D. Film exposure and development
   E. Printing and enlarging
   F. Impact of photography
   G. Career awareness

VI. Graphic Arts (two and one-half weeks)
   A. Printing processes
   B. Applications in industry
   C. Impact of graphic arts
   D. Technological developments in printing
   E. Career awareness

VII. Telecommunication (culminating experiences, two and one-half weeks)
   A. Telephones
   B. Satellites
   C. Computers
   D. Optical fibers
   E. Lasers
   F. Holography
   G. Impact of telecommunication
   H. The future
   I. Career awareness

This outline is only one suggested approach to the topic. In addition, the learning activities in each area will need to be tailored to the needs of each school, taking into account space limitations, equipment to be used, and grade level of the students.

Using the preceding outline as a class guide for communication technology at the ninth or tenth grade level, one might use the approach and learning activities listed below. Again, this is a sample and not the only approach possible.

SECTION I (one week)

Day One	*Teacher*	*Student Learning Activities*
Class orientation Define communication	Pass out class materials. Go over grading and your expectations of the students. Help students develop a definition of communication.	Student starts a list of local and national news items involving communication or noncommunication compiled from TV, news or newspaper. (List is due in on fifth day.)
Day Two		
Develop communication Animal communication	Help students build the communication technology model. Draw in parallel of God talking with man before and after sin. Select student to send message while group makes noise. Illustrate interference and noise. Have students select topic from animal kingdom to research animal communication—report back to class third day.	Select student to read sentence in front of room to student in rear of room while remaining students make noise. Student research about any of the following: ant, honeybee, whale, chimpanzee.
Day Three		
Report on animal kingdom communication History and development	Review research on animal kingdom and communication. Introduce concept of time line. Help students pick a time period to research important inventions developed in communication.	Student starts time line for a given period. (Project due near end of course.)

Day Four	*Teacher*	*Student Learning Activities*
Use of senses History and development	Go over five senses used in communication: sight, smell, hearing, touch, taste. (Make recording of common sounds to use as a quiz.)	Give students sound quiz. See how many sounds they can recognize. Make some with interference and noise. Illustrate points.
	Verbal communication without sight.	Divide class into groups of three. Blindfold two and have person who can see talk the other two through a maze. Make into relay.
	Taste—Place in small containers salt, sugar, powdered sugar, flour. Pass around and have groups try to identify by taste. (Have student dampen finger and insert into material then taste the material—do not allow tongue to be placed in material.)	Research on time line—students list jobs available in communication area using newspaper.
Day Five		
Career awareness	List available jobs to help students see career possibilities—necessary skills, working conditions, and pay.	Student turns in list of news items involving communication.

Space does not allow me to continue through the entire class outline, but the reader can see how easily other subject areas are integrated into a ninth or tenth grade general shop class on communication technology. During the first week, students used history and current events, biology and science, English and composition.

Using the technology education approach allows the teacher flexibility in challenging both fast and slow learners, helping them to select topics matching their abilities. The more capable students should be encouraged to research topics not covered in class: by providing space and encouragment, the teacher will not be disappointed. Projects can cross over into various disciplines.

But what about unmotivated students? By getting to know them the teacher will usually find something that will arouse their interest. Building upon this, the teacher can help them succeed. Technology education offers teachers a large range from which to choose in selecting topics to inspire the unmotivated student. Frequently the more current or futuristic a topic becomes, the more interest it sparks.

Using a technological approach . . . would require less costly and sophisticated equipment to teach any of the given clusters and would also add interest, enthusiasm, and variety to shop classes.

Another advantage to the technology education approach for exploratory-level shop classes is the cross over between subjects and the possibility of teaching more than traditional shop topics. English, math, science, and computers are just a few of the areas that might be emphasized. Through such an integration the student begins to see the use for and importance of other disciplines outside of the regular math or science class.

Math and Science Classes

After the students understand the above principles, math, science, and computing can be taught in a more inductive way since their concepts can be related to specific areas of technology. For students who seemingly have a mental block in learning math and science, this approach can serve as an effective tool.

Using a technological approach, shop classes at the exploratory level will provide a broader perspective than is currently being offered. This approach would require less costly and sophisticated equipment to teach the clusters listed above and add interest, enthusiasm, and variety to shop classes.

Keep Safety Concepts in Mind

Safety education is an important part of technological training. Many hazards exist in laboratories and shop classes. Safety hazards could include dangers to the eyes, ears, or lungs, depending on the materials and processes utilized. Teachers must remember their impact on the class in setting an example of safe behavior. If they expect safety glasses to be worn by students, then they must wear them themselves. Teachers must continually stress safety to the student in the use of materials, tools, and equipment. In planning learning activities teachers should keep in mind the following questions:

1. What materials will the student utilize, and what safety hazards exist in using these materials?
2. What tools, equipment, or processes

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but also as a *revelation* by which men and women can more completely fulfill God's directions. God commanded Adam and Eve to subdue the earth and have dominion over it. Technological knowledge is the tool by which humankind can to a greater extent fulfill this objective.[20]

Stewardship Over Earth's Resources

Unfortunately, we have been somewhat overzealous in this regard. Having dominion over the earth in the Biblical context does not imply thoughtless or selfish abuse of Earth's resources as often happens in strip mining and chemical dumping. Subduing and dominating the planet must be balanced with God's broader ecological directives such as concern for all aspects of creation and the well-being of all people.

Teachers will have to do a good deal of thoughtful and innovative planning to integrate these principles into the curriculum, but it can be done. For example, in drawing classes, the student is often given the assignment of designing and drawing a residential dwelling. This project often results in the students competing to see who can design the biggest, most expensive, most exotic house. A more fitting assignment might be to design a dwelling for a particular developing country. To do so, students would have to research the style of living, specific requirements of the occupants and materials available in the area, while at the same time accommodating ecological principles. This would satisfy the goals of architectural drawing while sensitizing students to the needs, environments, and concerns of other people.

Traditionally, industrial arts has examined the iron and steel industry, with its use of traditional fuels such as oil and coal. However, students, as custodians of Earth's resources, could better spend their time concentrating on renewable energy sources such as wind, tides, and solar energy.[21] They could construct models that harness these types of energy on a small scale or in the context of a design problem. This would require testing, measurement of output, and resulting modifications.

If the goals of Christian education are to be reached in our schools, and graduates are to be adequately prepared for life in a technological society, then technology education cannot be an elective—it is an imperative that curriculum planners must address. Adventist educators need to give prayerful thought to their responsibility to promote a pervasive Christian philosophy that relates to all aspects of life in a technological society. □

FOOTNOTES

[1] M. James Benson, "The Soaring Technology Revolution," *The Technology Teacher*, 44:4 (January, 1985), p. 4.

[2] John McHale, *The Future of the Future* (New York: George Braziller, 1969), p. 15.

[3] Kendall N. Starkweather, "A Study of Potential Directions for Industrial Arts Toward the Year 2000," *Journal of Industrial Teacher Education*, 13:2 (Winter, 1976), p. 64.

[4] J. Barry Duvall, "The Year 2000 and Industrial Arts," *Man/Society/Technology* (May-June, 1980), p. 19.

[5] Donald Maley, "Perspectives on the Future: Industrial Arts Plays a Key Role in Future Education," *Man/Society/Technology*, 36 (January, 1980), pp. 10-15, 29, 30.

[6] John C. Walters, "Technology Education: Teaching Industrial Arts to Its Fullest Potential," *Man/Society/Technology*, 36 (May-June, 1977), pp. 233-235.

[7] Ronald M. Mangano, "Industrial Arts, Technology, and the Future," *Man/Society/Technology*, 42 (April, 1976), pp. 141, 147-149, 158.

[8] Starkweather.

[9] Delmar W. Olsen, "Interpreting a Technological Society: The Function of Industrial Arts," *School Shop*, 33:7 (March, 1974), pp. 35, 36.

[10] Gordon F. Martin, "Curriculum Implications for Technology Education—1990," *Man/Society/Technology*, 42 (April, 1983), p. 6.

[11] Olson, p. 36.

[12] Maley, p. 12.

[13] Robert D. Vickery, *Curriculum Guide for Power Technology* (Elwood, IN: Elwood Community High School, n.d.).

[14] Kendall N. Starkweather, "Industrial Arts in a Post-Industrial Age," *American Vocational Journal*, 51:8 (November, 1976), p. 82.

[15] M. J. Benson, "Summary—A Parting Perspective," in H. A. Anderson and M. J. Benson, eds., *Technology and Society: Interfaces With Industrial Arts, American Council on Industrial Arts Teacher Education 29th Yearbook* (Bloomington, IL: McKnight, 1979), p. 335.

[16] At least 11 books plus plans and other information are available on model rocketry from Estes Industries, Inc., Penrose, CO 81240.

[17] North American Division Office of Education, *Framework for Applied Arts* (Washington, DC: General Conference of SDA, 1979), p. iii.

[18] Gerald Laverman, *Industrial Arts in the Christian School* (Chicago: National Union of Christian Schools, 1970), p. 21.

[19] *Ibid.*, p. 17.

[20] *Ibid.*, pp. 20, 21.

[21] Glenn Mider, *Renewable Energy Systems*, Eastern Illinois University.

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will students use in this learning activity? What safety hazards exist, and what procedure will I follow to educate the student concerning these hazards?

3. What method will I use to be sure the students understand safety procedures and habits? What steps should I take if one of the students has an accident?

In order for students to become technologically literate in our modern society teachers must use technological advances as steppingstones to help the pupils understand the subject at hand, including the way technology is changing our present and future society and the advantages that can result from these changes. □

FOOTNOTES

[1] Los Angeles Trade-Technical College, CA. *Master Plan for the Introduction of High Technology Instructional Programs*. Office of Instruction Report No. 82-1 (Bethesda, MD: ERIC Document Reproduction Service, ED 248912, 1982), p. 8.

[2] *Ibid.*

[3] Wisconsin State Department of Public Instruction, Madison. *Industry and Technology Education. A Guide for Curriculum Designers, Implementors, and Teachers. Bulletin No. 4432* (Bethesda, MD: ERIC Document Reproduction Service, ED 248340, 1984), p. 9.

[4] Stephen Solomon, "Designing Artificial Joints by Computer," *Technology Review*, 87:7 (October, 1984), pp. 76, 77.

[5] Richard H. Hersh, "On Roads, Bridges, and Schools: The Infrastructure Necessary for Technology Literacy," *American Association for Higher Education Bulletin*, 35:7 (March, 1983), p. 4.

[6] Timothy B. Jay, "The Future of Educational Technology," *Educational Technology*, 22:6 (June, 1982), p. 22.

[7] Illinois State Board of Education. *Communication Technology Curriculum Guide 1984* (Springfield, IL: Department of Adult, Vocational, and Technical Education).