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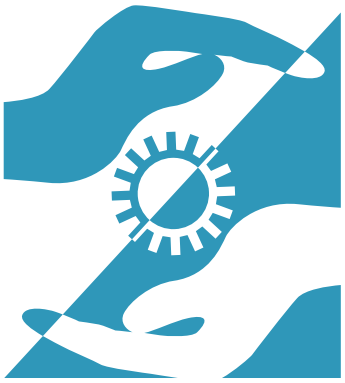


TECHNOLOGY EDUCATION 8 TO 10

Integrated Resource Package 1995

Province of
British Columbia
Ministry of
Education

IRP 014

This Integrated Resource Package (IRP) contains prescribed learning outcomes and support materials for the Grades 8 to10 Technology Education curriculum. It has been designed to help teachers identify possible ways to link learning outcomes, instructional strategies, and assessment strategies.

Principles of Learning

Technology education should be guided by the principles of learning. These are:

- Learning requires the active participation of the student.
- People learn in a variety of ways and at different rates.
- Learning is both an individual and a group process.

Rationale

Technology is embodied in devices that extend human capabilities. It provides the tools to extend our vision, to send and receive sounds and images from around the world, and to improve health, personal relationships, lifestyle, economies, and ecosystems.

Technology is a dominant force in today's society. Technological literacy is as essential to participation in modern society as is numeracy and the ability to read and write. A technologically literate person uses tools, materials, systems, and processes in an informed, ethical, and responsible way. Technology education helps young people prepare to live and work in a technological world.

The Aim and Approach of The Curriculum

The aim of the Grades K to 12 Technology Education curriculum is to help students develop the technological literacy and lifelong learning patterns that they need to live and work effectively in a changing technological society. To achieve this, the curriculum provides a framework for students to learn how to design and make solutions to real-world problems.

Preparing for the Workplace

To meet career challenges, students must be able to make independent decisions, solve problems, work independently and co-operatively with others, and become technically competent. Technology education helps students develop the types of learning patterns that are required in today's changing workplace.

Preparing the Citizen

To be responsible members of society, students must be aware of the ever-growing impacts of technology. They need to reflect critically on technology's role in society and consider its positive and negative effects. Technology education fosters the development of skills and attitudes that increase students' abilities to address the social and ethical issues of technological advancements.

Relevant to Everyone

The Grades K to 12 Technology Education curriculum is designed to provide learning opportunities for male and female students with a wide range of abilities. The instructional and assessment strategies described in this Integrated Resource Package encourage students to apply skills and knowledge gained in and out of the classroom to the design and making of solutions to real-life problems. As students study technology related to the materials, tools, and processes used in their design and practical work, they develop research skills and learn how to evaluate their work. Because of the changing

nature of society and the workplace, the skills, knowledge, and attitudes developed in technology education are relevant to many other areas of life.

Preparing for Further Education

The technology education curriculum spans Kindergarten to Grade 12. It provides a framework for students to solve problems using a design process and make what they have designed. The aim of the curriculum is to develop technological literacy and lifelong learning patterns that will enable students to live and work effectively in a changing technological society. The following provides an overview of technology education, Kindergarten to Grade 12.

OVERVIEW

Grades K to 3	
Students begin to appreciate that technology is everywhere. They become aware of the role of technology in their lives by exploring familiar devices. Through problem-solving activities, they develop group interaction and communication skills, and self-confidence in handling simple processes and products. Student activities are based on classroom themes and their own experiences and personal interests.	***In grades K to 3, students:*** • construct devices that are useful and relevant to them • explore materials, tools, and processes, independently and in groups • realize that there are several solutions to a single problem • learn the importance of using tools and materials safely
Grades 4 to 7	
Students consider the personal, community, and global consequences in the use of technology now and in the future, and develop a concern for its responsible application. They investigate the historical development of technology and begin to appreciate its impact on society and individuals. By investigating a product from its inception to its completion, students learn to research, create, and communicate solutions to design problems.	***In grades 4 to 7, students:*** • gain experience using a variety of communication tools (e.g., modem, CD-ROM, video, overhead projector) • identify problems involving design and investigate possible solutions • use an expanding variety of tools, materials, and production processes • use objective tests and feedback to refine and modify designs • become increasingly responsible for managing their time and resources, and for planning and organizing their activities within a specific task • begin to recognize that a system is made up of parts and devices that interact to achieve a purpose

Grades 8 to 10	
Students work in specialized environments to develop and use technological solutions to problems that they identify or that are identified for them. They continue to learn about the technical requirements of various careers. They consider the personal, local, and global consequences, and the cultural, ethical, and aesthetic implications of technology. They investigate the future applications of technology to improve the human condition.	***In grades 8 to 10, students:*** • set goals, develop plans, and assess their own ability to design products (individually and in groups) • use graphic designs and oral and written language to convey technical ideas • learn about the safe use of specialized tools and machinery • consider how they will use technology in daily life and in the workplace • study the characteristics and uses of materials and information while solving problems involving design that occur in daily life and in the workplace • learn to create and manage systems that energize and control products
Grades 11 to 12	
Students work in a sophisticated technological learning environment designed to promote their skills, knowledge, and abilities to solve complex and varied problems. Students take advantage of opportunities to prepare for postsecondary training opportunities.	***In grades 11 to 12, students:*** • develop skills appropriate to the workplace • produce products and systems that meet community standards • work in co-operative groups to develop solutions to real-life problems • develop detailed understanding of materials, processes, systems, and information gathering • select appropriate technologies to solve problems • evaluate possible solutions using models, simulations, and prototypes

Curriculum Organizers

The prescribed learning outcomes for technology education are grouped into the following five curriculum organizers:

- Self and Society
- Communications
- Production
- Control
- Energy and Power

These five curriculum organizers are the key elements of technology education. They were developed to provide a framework for the learning outcomes—a way of organizing knowledge, skills and attitudes. Because of the dynamic nature of classroom learning, no one organizer should be used in isolation or as a basis for a lesson or unit of instruction.

Although all organizers work together in various ways, learning outcomes in Self and Society focus on career development and personal and social responsibility, making these learning outcomes central to all activities in technology education.

Self and Society

Technology touches our lives every day. Students need to understand how humans shape technology and the impact that current and future technologies will have on our society, culture, and environment. The prescribed learning outcomes emphasize:

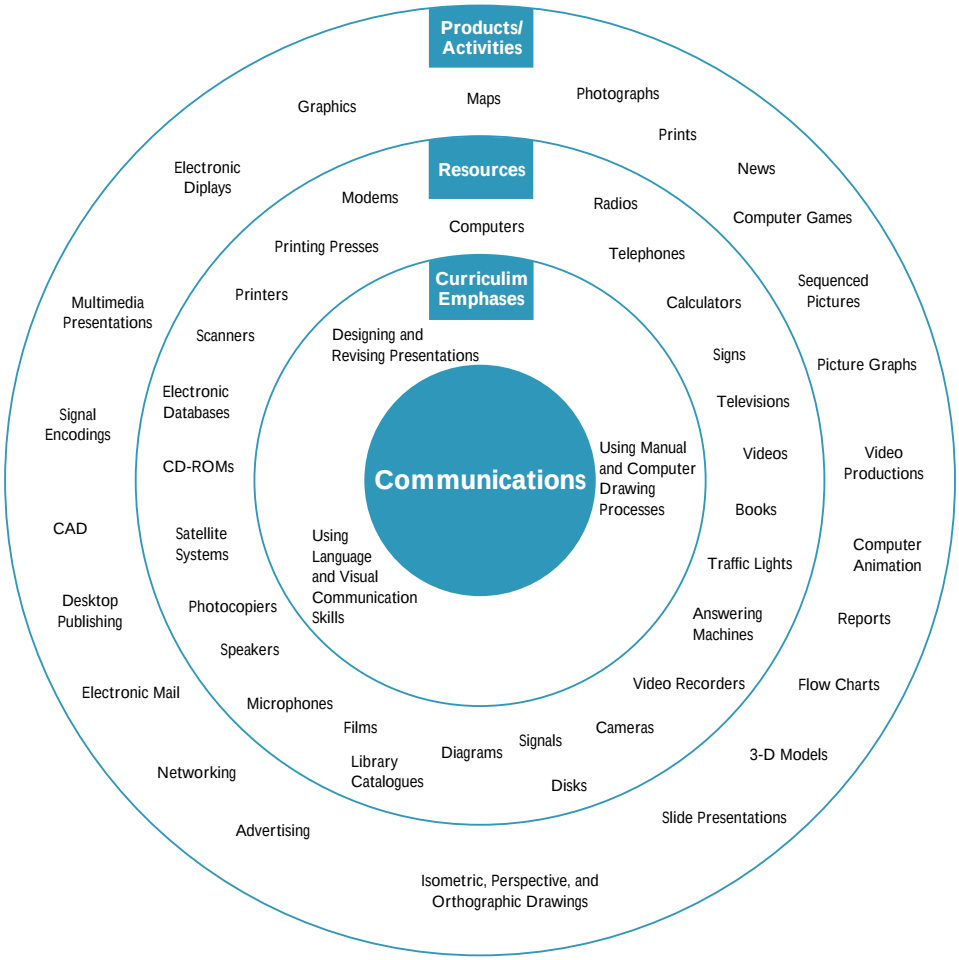
- learning to solve design problems involving technology
- the personal relevance of problems involving technology and the discovery that there may be several solutions to a problem
- developing positive attitudes toward lifelong learning and the integration and application of skills across areas of learning and technologies
- developing appropriate interpersonal skills and attitudes for working both independently and co-operatively within a group
- exploring careers and lifestyles associated with technology
- discovering how technology has changed society and the workplace

Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Communications

Images and messages can be sent instantly almost anywhere in the world, adding a global perspective to our lives. At home and in the workplace, students will need to use technology to process and share information and to communicate ideas using language and graphic forms. The prescribed learning outcomes emphasize:

- using technology to access, store, and retrieve information (although information technology is a separate curriculum, it is a major part of technology education)
- developing knowledge and skills related to accessing, storing, retrieving, and using information
- using manual and computer-assisted processes to present models and simulations in 2-D and 3-D forms to explain design ideas
- developing and using criteria to create and revise design presentations
- making use of skills, knowledge, and technologies from various curriculum areas to solve problems
- making responsible choices about the use of technology

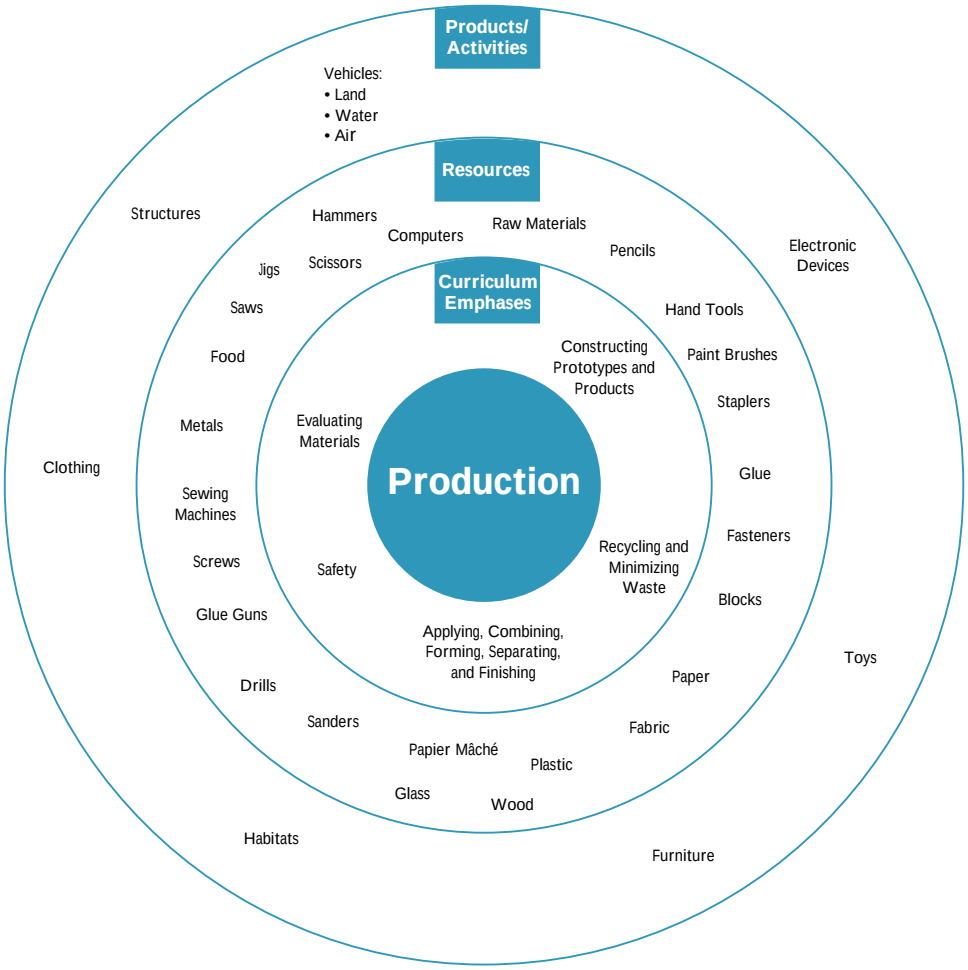


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Production

The introduction of new technologies has influenced the way we create and make things. Students need to know about the safe use of tools and materials. They acquire skills by designing and developing products and systems that satisfy human needs and wants. The prescribed learning outcomes emphasize:

- applying the processes of combining, forming, separating, and finishing to the development and improvement of products at home and in the industrial world
- evaluating and selecting materials to meet specific design requirements
- constructing models, prototypes, and products to detailed specifications
- investigating the effects of technological changes on the production and use of materials
- examining processes and procedures used to minimize waste and to reuse products
- developing appropriate attitudes and practices about working safely, whether in the workplace, at home, or in the school laboratory

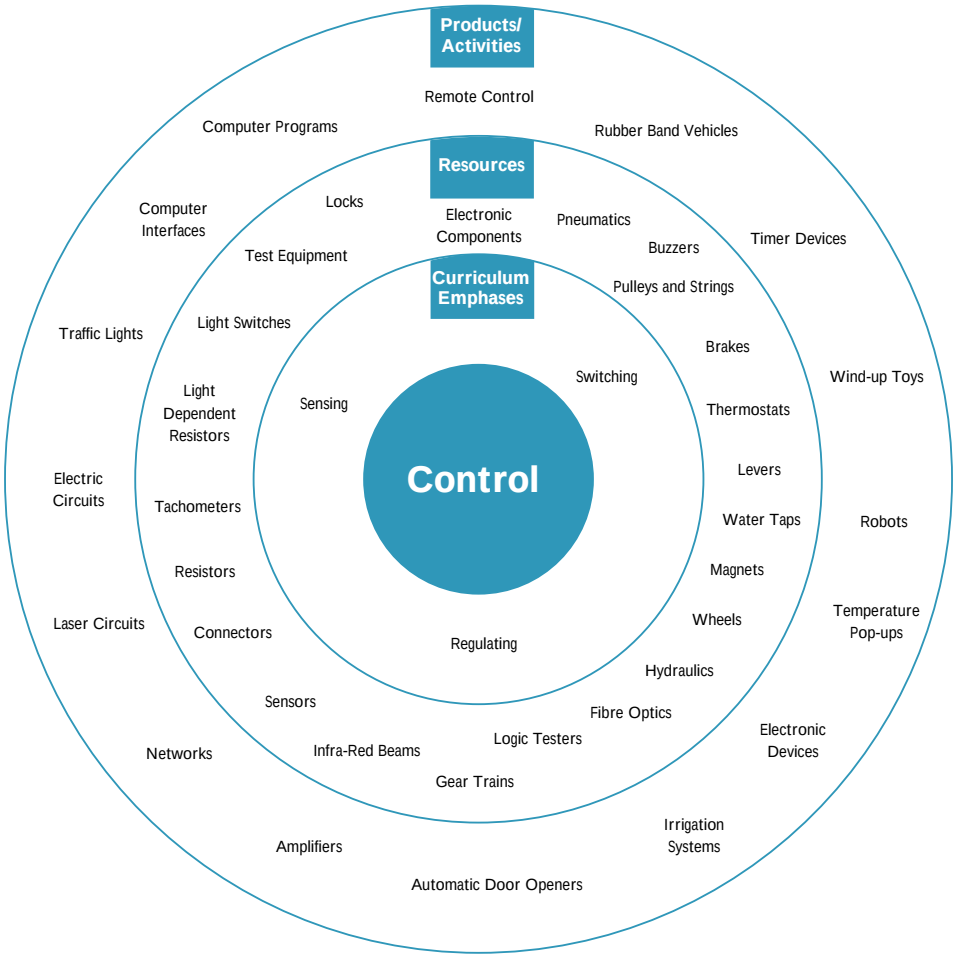


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Control

Control addresses the application of devices and processes to manage, sort, control, and organize systems. The prescribed learning outcomes emphasize identifying and designing devices and processes in systems that integrate the following:

- *Sensing:* detecting, interpreting, and monitoring energy in a system using electric, electronic, fluid, or mechanical devices. Information is processed, and a decision is made that results in a specific outcome (e.g., the auto-stop function on a cassette player; an infra-red beam on a conveyor belt counts boxes as they pass).
- *Switching:* any method (e.g., mechanical, electronic) used to turn the flow of energy in a system off and on (e.g., a motion detector activates an alarm when an intruder is present; triggering the start of a model car on a ramp).
- *Regulating:* varying the flow, amount, and direction of all forms of energy (e.g., human, fluid, mechanical, electrical, heat).

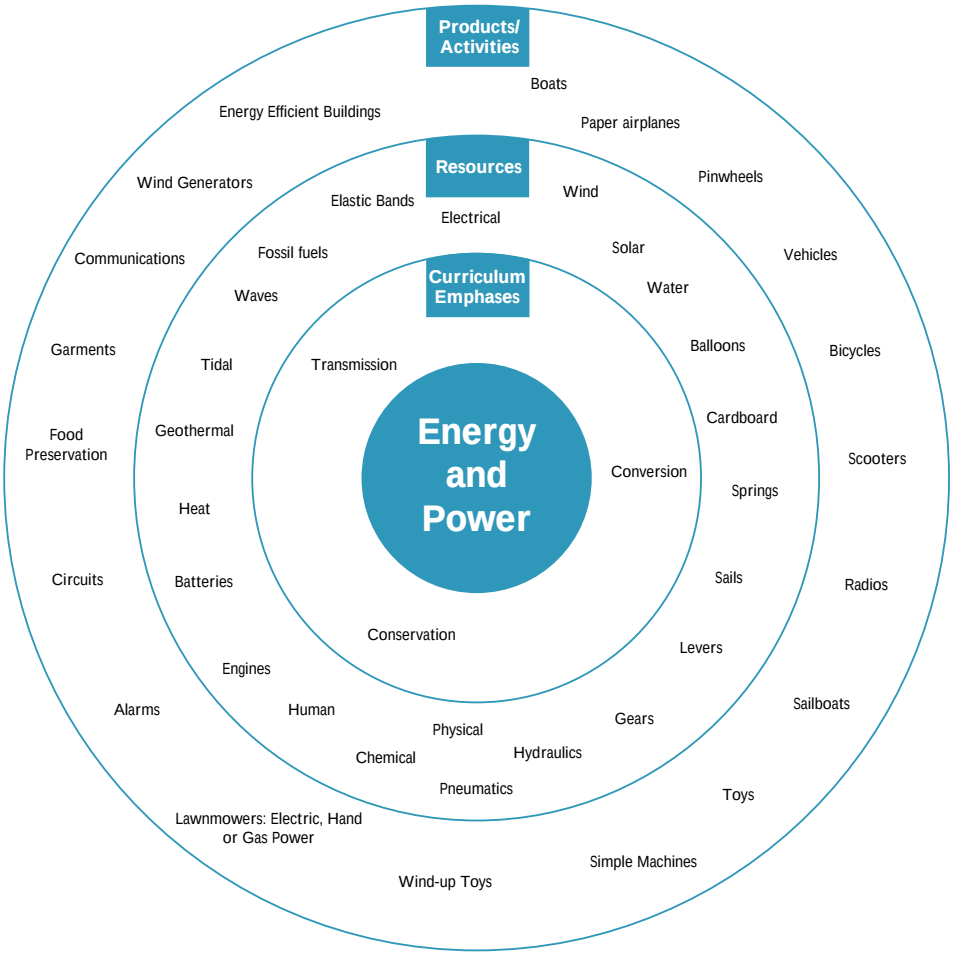


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Energy and Power

Energy and Power refers to devices and processes that convert, transmit, and conserve forms of energy. The prescribed learning outcomes emphasize the analysis, design, and construction of systems that apply the following principles:

- *Conversion:* when energy is changed from one form to another (e.g., energy stored in a battery is converted into mechanical energy by an electric motor).
- *Transmission:* using devices and systems to transfer energy from one location to another (e.g., energy is transmitted from an electric motor through gears that turn the wheels of a model car, causing it to move).
- *Conservation:* using existing energy efficiently and finding alternative energy forms (e.g., aerodynamically designed vehicles; using solar energy to toast bread).



Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Instructional Strategies

The instructional strategies suggested in this IRP include techniques, ideas, and methods that illustrate a variety of approaches to the prescribed curriculum for a diverse population of students. Teachers determine the best instruction methods for their students, the best way to group students for particular studies, and the best way to present material to make it relevant and interesting.

Context Statements

Each set of instructional strategies in this IRP starts with a context statement, followed by several examples of instructional activities. The context statement links the prescribed learning outcomes with instruction. It states why these learning outcomes are important for the student's development and suggests some ways to integrate the learning outcomes into various subject areas.

Strategies

The suggested instructional strategies may be undertaken by individual students, partners, or small groups. Technology education emphasizes the skills needed in a continually changing workplace. Emphasis is given to the following:

- **Strategies that foster the development of individual and group skills**. The workplace requires that people work effectively, individually and with others, to solve problems and to complete tasks. Students need to experience the dynamics of group work to enhance their understanding of the problem-solving process. Group work focusses on such skills as collaboration, communication, leadership, and cooperation.
- **Strategies that develop applied skills**. In order to see technology education as relevant and useful, students must learn how it can be applied to a variety of real-world situations. Technology education helps students to understand and interpret their world, and to identify and solve problems that occur in their daily lives.

  As students access, synthesize, and present information, they apply their skills in various subject areas. They listen, read, write, and present ideas for various purposes, find specific information and summarize it graphically and in writing, and apply their knowledge of mathematics and science to the projects they develop.
- **Strategies that foster research and critical-thinking skills**. In order to make informed and responsible choices about the appropriate use of technology, students need to listen, view, and read critically.
- **Strategies that use technology**. The ability to use technology to solve problems is becoming a mandatory skill in the workplace and is an important "new basic" in postsecondary education. Students use technology to access information, to calculate, and to enhance the presentation of ideas.
- **Strategies that require the solving of problems involving design**. Students identify needs, pose real or invented problems of their own, and respond to problems presented by the teacher.

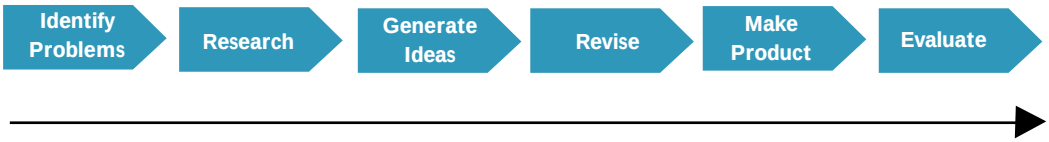
  To develop decision-making and problem-solving skills, students need to be challenged to identify problems and present appropriate design solutions. The problems students identify or are assigned in technology education involve the development of new or improved products and systems.

Problem-Solving Models

Models that describe problem-solving processes should be developed with students so they understand the recurring nature of solving real-world problems (as part of a problem is solved, new problems arise and some steps in the processes recur). The following diagrams present a variety of approaches to describe problem-solving in technology education. They are intended to provide teachers with ideas. They are not intended as prescribed models.

A Simple Linear Model

Some models suggest that problem solving is a set of clearly defined and prescribed steps. This is rarely the case.



Designing, Troubleshooting and Social Impact Models

Some specialized problems are approached in unique ways

Troubleshooting

Troubleshooting is a method of solving problems used to isolate and diagnose a malfunction.

- Identify purpose of system (inputs and outputs)
- Identify purpose of subsystems (inputs and outputs)
- Test subsystems
- Identify cause and implement solution
- Test solution

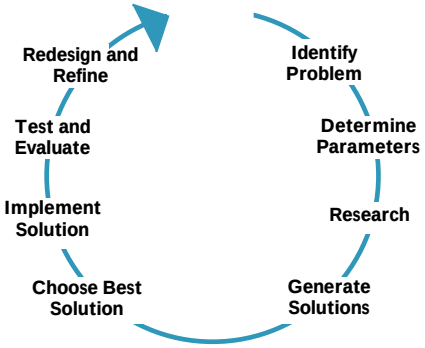
Social Impact

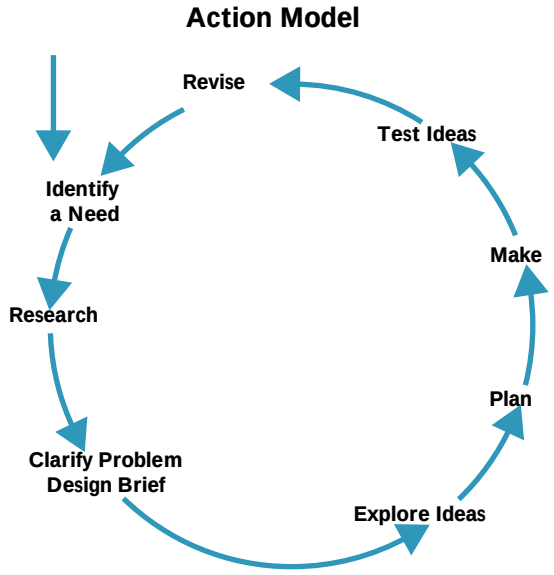
This is a method of solving problems used to appraise the social, environmental, and ethical implications of technological decisions.

- Identify consequences and effects
- Develop a value system through critical thinking
- Judge benefits and disadvantages of technological applications
- Make ethical decisions

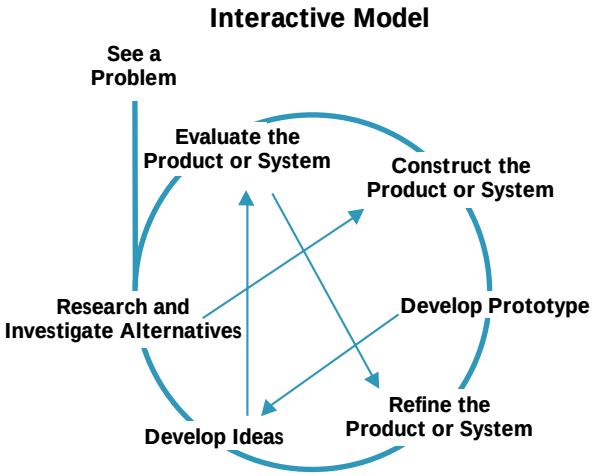
Designing

Designing is a problem-solving method used to develop solutions leading to the creation of articles, systems, or environments.





Some models suggest a continuous flow of activity, from problem identification to the development of a refined product.



Interactive models illustrate the complexity of a process, where at any time you might move to any point in the process in order to figure something out.

CONSIDERATIONS FOR INSTRUCTION IN TECHNOLOGY EDUCATION

When selecting and developing learning activities, consideration must be given to safety, gender equity, and diverse student needs.

Safety

The nature of technology education requires that correct safety practices be established as soon as students begin their studies. It is the responsibility of the teacher to ensure that students are aware of the hazards in facilities and that established safety procedures are followed. Safety education is a continuing experience. Teachers must use good judgment when instructing students in safety practices, remembering that the main objective is education.

It is essential that teachers address the following questions before, during, and after an activity:

- Has the instruction been sequenced progressively to ensure safety?
- Have students been given specific instruction about how to use and handle equipment and tools correctly?
- Are the tools and equipment in good repair and suitably arranged?
- Are students being properly supervised?
- Do the facilities provide adequate lighting and ventilation for the activity?
- Have students been made aware of hazards in the facility area?
- Have students been made aware of appropriate school-based and industrial safety standards?

Teachers should select safe activities, techniques, and projects, and ensure that the following safety practices are implemented. This is not an all-inclusive list but a guide to

help teachers establish a safe learning environment.

Students should:

- wear appropriate clothing and footwear
- follow established rules and routines
- select tasks that are within their ability
- demonstrate self control and show respect for the safety of others
- recognize hazards in work areas

Teachers should select activities, techniques, and projects that reflect safe practices.

Facilities

The technology education curriculum reflects a significant shift in focus from industrial education. The learning outcomes in the technology education IRP represent different expectations for student learning than were described in the industrial education curriculum guide.

Schools may already have the facilities and equipment needed to meet the needs of the technology education curriculum. However, for some schools, to accommodate changes in the curriculum, it may be necessary to modify their use of existing industrial education facilities.

Teachers can assist in this transition by rearranging existing instructional space to better meet the needs of students. For example, dividing existing space into separate areas for "clean" work (such as planning and design) and "dirty" work (such as material preparation) may be required. If there is no available clean (design or computer) space in the existing production area, it may be possible to share other space in the school for these purposes.

The suggested instructional and assessment strategies in this IRP provide teachers with many examples of ways to meet the intents of the technology education curriculum. The prescribed learning outcomes have been written in a way that allows teachers to use a variety of processes, in a variety of settings, to ensure their students can meet required expectations.

Gender Equity

The education system is committed to helping all students succeed. This is particularly important in this area because female participation is low in technology education courses and women tend not to choose careers that require technical skills. Teaching, assessment materials, learning activities, and classroom environments should place value on the experiences and contributions of all people from all cultures.

Teachers should consider the diversity of learning styles, gender bias in learning resources, and unintentional gender bias when teaching. The following instructional strategies are suggested to help teachers deliver a gender-sensitive technology education curriculum.

- Think about ways to feature female technologists or women who make extensive use of technology in their careers as guest speakers or subjects of study in the classroom.
- Design instruction to acknowledge differences in experiences and interests between girls and boys.
- Demonstrate the relevance of technology education to careers and to daily life in ways that may appeal to particular students in the class or school. Successful links include biology, environmental issues, architecture and design, computers, and current affairs.
- Explore not only the practical applications of technology education but also the human elements, such as the ways ideas

have changed throughout history, and the social and moral implications of technology.
- Explore ways of teaching the uses of design and technology that will appeal to all students.
- Provide practical learning opportunities designed specifically to help girls develop confidence and interest in technology education and non-traditional roles.
- Emphasize that technology is used by people with various interests and responsibilities.
- Provide opportunities for visual and hands-on activities. Experiments, demonstrations, field trips, and exercises that provide opportunities to explore the relevance of technology education are important for both girls and boys.

Diverse Student Needs

Instruction and assessment methods should be adapted to meet the needs of all students. When students with special needs are expected to achieve or surpass the learning outcomes set out in the technology education curriculum, regular grading practices and reporting procedures are followed. However, when students are not expected to achieve the learning outcomes, modifications must be noted in their Individual Education Plans (IEPs).

The following strategies may help students with special needs succeed in technology education:

Adapt the environment:

- Change the student's classroom seat.
- Make use of co-operative grouping.

Adapt presentations:

- Provide students with advance organizers of key technology education concepts.
- Demonstrate or model new concepts.
- Adjust the pace of activities as required.
- Use bilingual peers or volunteers to help ESL students (e.g., to clarify safety rules).

Adapt materials:

- Use techniques to make the organization of activities more explicit (e.g., colour code the steps used to solve a problem).
- Use manipulatives or large-print charts.
- Use large print on activity sheets.
- Use opaque overlays on text pages to reduce the quantity of visible print.
- Highlight key points on activity sheets.
- Use translated material for information such as safety rules.

Adapt methods of assistance:

- Have peers or volunteers help students with special needs.
- Have students with special needs help younger students.
- Have teacher assistants work with individuals and small groups of students with special needs.
- Work with consultants and support teachers to develop appropriate problem-solving activities and strategies for students with special needs.

Adapt methods of assessment:

- Allow students to demonstrate their understanding of technology education concepts in a variety of ways (e.g., murals, displays, models, puzzles, game boards).
- Modify assessment tools to match student needs. For example, oral tests, open-book tests, and tests with no time limit may allow students to better demonstrate their learning than traditional tests.
- Set achievable goals.
- Use computer programs that allow students to practise word processing and to record and track their results.

Provide opportunities for extension and practice:

- Require the completion of only a small amount of work at any given time.
- Simplify the way questions are worded to match the students' levels of understanding.
- Provide functional, practical opportunities for students to practice skills.

Assessment and Evaluation

Assessment is the systematic process of gathering information about students' learning in order to describe what they know, are able to do, and are working toward. From the evidence and information collected in assessments, teachers describe each student's learning and performance. They use this information to provide students with ongoing feedback, plan further instructional and learning activities, set subsequent learning goals, and determine areas requiring diagnostic teaching and intervention.

Teachers determine the purpose, aspects, or attributes of learning on which to focus the assessment. They also decide when to collect the evidence and the assessment methods, tools, or techniques most appropriate to use. Assessment focusses on the critical or significant aspects of the learning students will be asked to demonstrate. Students benefit when they clearly understand the learning goals and learning expectations.

Assessment in Technology Education

The activities suggested in this IRP illustrate a variety of strategies for observing and interacting with students and for collecting their work. Each set of assessment strategies begins with a context statement that suggests an overall approach for the assessment of content, processes, and procedures. Teachers may want to adapt some of the suggested activities to suit particular students or situations. While students perform activities, teachers use a variety of strategies to assess their levels of understanding in relation to outcomes. Possible strategies include performance assessment, oral and written reports, and student self-assessment. For further support, Appendix D of this IRP includes a more detailed discussion of assessment and evaluation.

The provincial reference sets are an additional resource that can be used to help teachers assess skills across curricular areas. The reference sets can help teachers establish criteria that focus assessments and provide a more complete picture of student development.

The reference sets include:

- *Evaluating Reading Across Curriculum* (RB 0034)
- *Evaluating Writing Across Curriculum* (RB 0020 & RB 0021)
- *Evaluating Problem Solving Across Curriculum* (RB 0053)
- *Evaluating Group Communication Skills Across Curriculum* (RB 0051)
- *Evaluating Mathematical Development Across Curriculum* (RB 0052)

A series of assessment handbooks have also been developed to provide guidance for teachers as they explore and expand their assessment repertoires.

- *Performance Assessment* (XX0246)
- *Portfolio Assessment* (XX0247)
- *Student-Centred Conferencing* (XX0248)
- *Student Self-Assessment* (XX0249)

Learning Resources

The ministry promotes the establishment of a resource-rich learning environment through the evaluation of educationally appropriate materials in a variety of media and formats. This includes, but is not limited to, materials in print, video, and software formats, as well as a combination of these formats intended for use by teachers and students. Resources that support provincial curricula are identified through an evaluation process in which practising teachers act as evaluators. Resources not on the provincially recommended list must be evaluated through a local board-approved process. It is expected that teachers will select resources from those that meet the provincial criteria and that suit their particular pedagogical needs and audiences.

The use of the learning resources involves the teacher as a facilitator of learning. However, students may be expected to have some choice in materials for specific purposes such as independent reading or research. Teachers are expected to use a variety of resources to support learning outcomes at any particular level. A multimedia approach is encouraged.

Some selected resources have been identified to support cross-curricular integration. The ministry also considers students with special needs in the evaluation and annotation of learning resources. Special format versions of some selected resources (Braille and taped-book formats) are also available.

Learning resources for use in British Columbia schools fall into one of three categories:

- provincially recommended materials
- provincially authorized materials
- locally evaluated materials

All learning resources used in schools must have either *recommended or authorized* designation or be approved through district evaluation and approval policies.

Provincially Recommended Materials

Materials evaluated through the provincial evaluation process, approved through minister's order, and purchased using targeted learning resource funds are categorized as *recommended* materials. These resources are listed in the print and CD-ROM versions of the *Catalogue of Learning Resources*.

Appendix B of this IRP includes a list of *recommended* resources for technology education.

Provincially Authorized Materials

Materials selected prior to 989 by curriculum committees and purchased through the Credit Allocation Plan are categorized as *authorized* materials. These resources are listed in the print and CD-ROM versions of the *Catalogue of Learning Resources*.

Locally Evaluated Materials

These are the materials evaluated through local (district and school) evaluation processes and approved for use according to district policy.